

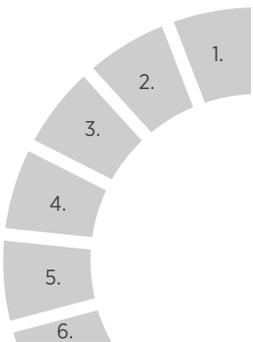


Food and Agriculture
Organization of the
United Nations



FAO REGIONAL STRATEGY ON FOOD LOSS AND WASTE REDUCTION IN ASIA AND THE PACIFIC





1. © shutterstock/Yoye Jantapoon
2. © shutterstock/ardianjusto
3. © shutterstock/Dwi Martono Photo
4. © shutterstock/Vietnam Stock Images
5. © shutterstock/Jahangir Alam Onuchcha
6. © shutterstock/Solarisys



FAO REGIONAL STRATEGY ON FOOD LOSS AND WASTE REDUCTION IN ASIA AND THE PACIFIC

Anthony Bennett, Sangita Dubey,
Warren T.K. Lee, Beau Damen and Camelia Bucatariu

Food and Agriculture Organization of the United Nations
Bangkok, 2022

Required Citation:

Bennett, A, Dubey, S., Lee, W.T.K., Damen, B. and Bucatariu, C. 2022. *FAO Regional Strategy on Food Loss and Waste Reduction in Asia and the Pacific*. Bangkok, FAO. <https://doi.org/10.4060/cb8959en>

The designations employed and the presentation of material in this information product do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations (FAO) concerning the legal or development status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. The mention of specific companies or products of manufacturers, whether or not these have been patented, does not imply that these have been endorsed or recommended by FAO in preference to others of a similar nature that are not mentioned.

The views expressed in this information product are those of the author(s) and do not necessarily reflect the views or policies of FAO.

ISBN 978-92-5-135884-9

© FAO, 2022



Some rights reserved. This work is made available under the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 IGO license (CC BY-NC-SA 3.0 IGO; <https://creativecommons.org/licenses/by-nc-sa/3.0/igo>).

Under the terms of this license, this work may be copied, redistributed and adapted for non-commercial purposes, provided that the work is appropriately cited. In any use of this work, there should be no suggestion that FAO endorses any specific organization, products or services. The use of the FAO logo is not permitted. If the work is adapted, then it must be licensed under the same or equivalent Creative Commons license. If a translation of this work is created, it must include the following disclaimer along with the required citation: "This translation was not created by the Food and Agriculture Organization of the United Nations (FAO). FAO is not responsible for the content or accuracy of this translation. The original English edition shall be the authoritative edition.

Any mediation relating to disputes arising under the license shall be conducted in accordance with the Arbitration Rules of the United Nations Commission on International Trade Law (UNCITRAL) as at present in force.

Third-party materials. Users wishing to reuse material from this work that is attributed to a third party, such as tables, figures or images, are responsible for determining whether permission is needed for that reuse and for obtaining permission from the copyright holder. The risk of claims resulting from infringement of any third-party-owned component in the work rests solely with the user.

Sales, rights and licensing. FAO information products are available on the FAO website (www.fao.org/publications) and can be purchased through publications-sales@fao.org. Requests for commercial use should be submitted via: www.fao.org/contact-us/licence-request. Queries regarding rights and licensing should be submitted to: copyright@fao.org.

CONTENTS

FOREWORD	vii
ACKNOWLEDGMENTS	viii
ABBREVIATIONS AND ACRONYMS	ix
EXECUTIVE SUMMARY	x

CHAPTER 1: FOOD LOSS AND FOOD WASTE **1**

1.1. Definitions	1
1.2. Causes	4
1.3. Overview of global, regional and national food loss and waste levels	7
1.4. Food security and socio-economic impacts along food supply chains and for consumers	12
1.4.1. Hidden nutrient loss due to food loss and waste along supply chains – Implications for healthy diets and nutrition	14
1.5. Sustainable Development Goal target 12.3 and indicators	18
1.5.1. Global Food Loss Index	20
1.5.2. National Food Loss Index and food loss percentage calculations	20
1.6. Global food loss and food waste policy setting	21
1.6.1. Global Food Loss and Waste Database, the Technical Platform on Measurement and Reduction of Food Loss and Waste, and the Group of 20 (G20)	24
1.7. Regional experiences and lessons learned that guide the approach to the FAO Regional Strategy on Food Loss and Waste Reduction in Asia and the Pacific	26
1.7.1. Latin America and the Caribbean	26
1.7.2. Africa	28
1.7.3. Near East and North Africa	29
1.7.4. Europe and Central Asia	31
1.7.5. Analysis of regional experiences and lessons learned	34
1.8. Overview of engagements in FLW prevention and reduction by international financial institutions, the private sector and civil society	36
1.8.1. International financial institutions	36
1.8.2. Private sector initiatives	38
1.8.3. Civil society initiatives	41
1.8.4. Public, private and civil society social and technological innovations	43
1.8.5. Analysis of engagement in FLW prevention and reduction	46

CHAPTER 2: WHY AN ASIA-PACIFIC FOOD LOSS AND WASTE STRATEGY? **47**

2.1. The need for strategy and action in Asia and the Pacific	47
2.1.1. Policies, strategies and actions on food loss and waste reduction	49
2.1.2. Overview of key players active in food loss and waste reduction	49
2.1.2.1. Asia-Pacific Economic Cooperation (APEC)	49
2.1.2.2. Association of Southeast Asian Nations (ASEAN)	51
2.2. Country-level approaches to food loss and waste	52
2.2.1. China	52
2.2.2. Australia	56
2.2.3. Thailand	57
2.2.4. Nepal	59
2.3. Food loss and waste work by FAO in Asia and the Pacific	60
2.4. Analysis of food loss and waste strategy in Asia and the Pacific	61

CHAPTER 3: FOOD LOSS AND WASTE, CLIMATE CHANGE AND THE ENVIRONMENT		63
3.1. Introduction		63
3.2. FLW and climate change in Asia and the Pacific		66
3.3. FLW and landfill disposal		68
3.4. Water impacts of FLW		68
3.5. Land use and biodiversity impacts of FLW		70
3.6. Addressing the impact of FLW on the environment		71
CHAPTER 4: REGIONAL STRATEGY ON FOOD LOSS AND WASTE REDUCTION FOR ASIA AND THE PACIFIC		77
4.1. Vision, goal and strategic objective		77
4.2. The Five Pillars		78
4.2.1. Pillar 1: Raise awareness and enable state and non-state collaborations and partnerships on FLW prevention and reduction		78
4.2.2. Pillar 2: Identify and address food loss and waste at critical points along supply chains and at the consumer level		80
4.2.3. Pillar 3: Enable investments for FLW prevention and reduction		81
4.2.4. Pillar 4: Monitor and facilitate national and regional progress towards SDG target 12.3		82
4.2.5. Pillar 5: Support Asia and the Pacific Member Nations to develop and implement coherent governance frameworks for addressing FLW prevention and reduction		83
CHAPTER 5: CONCLUSIONS AND WAY FORWARD		85
References		88
Annexes		96
Annex 1: Steps for compiling national and global food loss indices		96
Annex 2: The FAO methodology for food loss assessment and finding solutions at the food supply chain level		97
Annex 3: Nepal: Issues, strategies and action plans for the reduction of post-harvest losses		98

TABLES, FIGURES AND BOXES

Figures

Figure 1: Conceptual framework for food loss and waste	3
Figure 2: Food loss from post-harvest to distribution, global and regional percentages, 2016	8
Figure 3: Potential price and income effects of food loss and waste reduction at various points in the food supply chain	14
Figure 4: Food loss percentages in different metrics, global and regional levels, 2016 baseline	15
Figure 5: SDG indicator 12.3.1 operational boundaries of food supply chains	19
Figure 6: Example of compiling, monitoring and reporting for a national Food Loss Index	20
Figure 7: Food flows from a Kroger store in Arizona through a food bank and to pantries	41
Figure 8: A food-use-not-waste hierarchy to minimize food loss and waste	49
Figure 9: Pyramid structure of grain storage and associated loss rate in China	54
Figure 10: Contribution of each commodity's FLW to the carbon footprint at the global level	66
Figure 11: Contribution of each phase of the food supply chain to the carbon footprint, and food loss and waste	67
Figure 12: Total FLW compared to the blue water footprint for consumption of agricultural products of the top 10 countries	69

Figure 13: Contribution of each commodity to FLW and its blue water footprint	69
Figure 14: Contribution of each commodity to FLW and land occupation	70
Figure 15: Land occupation of FLW by region	70
Figure 16: Food sector plausible scenario emissions and adoption results, 2020 to 2050	71
Figure 17: Food loss and waste reduction-related policies and measures, by type, in the nationally determined contributions of countries in Asia	72
Figure 18: The Five Pillars of the FAO Regional Strategy on FLW Reduction in Asia and the Pacific	78

Tables

Table 1: Data available on food loss and waste in APEC economies	10
Table 2: Food loss and waste reduction targets and reduction plans in Asia and the Pacific	50
Table 3: Regulations, policies and plans for food waste reduction and treatment in China	52
Table 4: Food losses during storage in China, 2011	54
Table 5: Main global environmental impacts of food loss and waste	64
Table 6: Potential mitigation or adaptation measures to reduce or prevent FLW that could be incorporated as priorities under nationally determined contributions	73

Boxes

Box 1: Timor-Leste: Critical loss points for selected maize value chains	4
Box 2: United States of America: Strategy on food loss and waste	6
Box 3: Palau: Food waste separate collection is key to food waste reduction	7
Box 4: India: Identification and analysis of critical loss points in selected mango supply chains	9
Box 5: China: Prevention and reduction of food waste by consumers as change agents	11
Box 6: International Fund for Agricultural Development (IFAD): Grant portfolio for food loss prevention with a focus on small food producers	13
Box 7: Global Panel on Agriculture and Food Systems for Nutrition: Priority areas of action to prevent loss and waste of nutrients	16
Box 8: Nigeria and Indonesia: Reducing post-harvest loss and improving nutrition	17
Box 9: Blue Growth Initiative, Fish4ACP and FAO e-learning course: Relevance of sex-disaggregated data for fisheries food loss and waste	23
Box 10: FAO, the African Union, and the Rockefeller Foundation: Project on Support to the African Union in the development of policies and strategies for national plans to reduce post-harvest losses	28
Box 11: The United Republic of Tanzania: National Postharvest Management Strategy 2019 to 2029	30
Box 12: FoodWise in Mauritius, Madagascar, Côte d'Ivoire and Morocco: Food waste prevention through business innovation and support to food insecure children and adults	31
Box 13: Türkiye: National Strategy and Action Plan on the Prevention and Reduction of Food Loss and Waste	34
Box 14: Tesco stores going into global food waste reduction	39
Box 15: Brief overview on the impact of food banks and their partners	42
Box 16: Mumbai, India: Roti Bank	43
Box 17: Champions 12.3: Strategies for reducing food loss and waste in restaurants	45
Box 18: China: Clean your plate campaign for food services and consumers' food waste reduction	55
Box 19: Thailand: Direct measurement of banana and mung bean loss	58
Box 20: Japan: Divert food waste from landfill with consumers as key change makers	65
Box 21: Singapore: Food waste – segregate, recycle, and reduce disposal and haulage fees	74



FOREWORD

Food loss and waste (FLW) is a persistent issue of growing concern for Asia and the Pacific region and the world. FLW impacts both rural and urban communities. When food is lost or wasted, so are limited natural, financial, and human resources. Food insecurity is affecting millions of people. Unnecessary greenhouse gas emissions are accelerating climate change.^{1,2,3} The COVID-19 pandemic has exposed the fragilities of food systems. These weaknesses have not yet been adequately addressed and lead to frequently recurring food waste and loss.⁴ Frailties in food systems include gaps in producers' capacity to face unforeseen conditions for harvest, a lack of local producer-to-consumer markets, and an absence of networks focused on recovery and redistribution of safe and nutritious food for direct human consumption.

Global state and non-state actors recognize the urgency of preventing FLW. In November 2020, participants at a virtual high-level event launched the *Food Coalition – A Global Alliance to prevent the health crisis becoming a food crisis*. A network of networks, the Food Coalition is a voluntary grouping. Earlier that year in March, the G20 Agriculture and Water Ministers meeting called for improved awareness, novel practices and innovative approaches to reduce and prevent FLW.

Overweight and obesity are on the rise in Asia and the Pacific even as the region works to improve food and nutrition security for 479 million of its people who are among the world's undernourished.⁵ Reducing FLW can contribute to changing this reality, within the framework of improving and delivering sustainable and resilient rural and urban food systems for all stakeholders, including consumers.

Sustainable Development Goal (SDG) 12 calls on countries to “ensure sustainable consumption and production patterns.” SDG target 12.3 is to “halve per capita global food waste at the retail

and consumer levels and reduce food losses along production and supply chains, including post-harvest losses” by 2030. FAO’s strategic framework is aligned with SDG target 12.3. In 2018, FAO Member Nations expressed interest in and requested guidance on FLW from FAO at the Regional Conference in Fiji. The 2020 FAO digital Conference⁶ highlighted the relevance of improving the monitoring and reporting for SDG target 12.3 and building back better through sound policies and programmes that place greater focus on reducing food loss and waste. Achieving SDG target 12.3 could reduce the food systems’ environmental impacts by up to one-sixth, or 16 percent.⁷

This is the first *FAO Regional Strategy on Food Loss and Waste Reduction in Asia and the Pacific*. The approach is based on a literature review, detailed national case studies in China, Thailand, Nepal and Australia, and lessons learned from other regions such as Africa, Europe and Central Asia, Latin America and the Caribbean, and the Near East and North Africa. From 1 to 2 June 2021, a regional virtual consultation took place on the strategy and its roadmap for implementation. The strategy has the objective of supporting FAO Member Nations in delivering on SDG target 12.3. Delivering on the target can be achieved through fast-track and effective investment in technical and governance capacity; strengthening state and non-state collaborations and partnerships while contributing to zero FLW, one of the five pillars of the Zero Hunger Challenge; and through SDG 1 (*End poverty in all its forms everywhere*) and SDG 2 (*End hunger, achieve food security and improved nutrition and promote sustainable agriculture*).



Working together we can make it happen.

JongJin Kim, ADG RAP

ACKNOWLEDGEMENTS

The FAO Regional Strategy on Food Loss and Waste Reduction in Asia and the Pacific was prepared by a multidisciplinary writing team at the FAO Regional Office for Asia and the Pacific (FAORAP), under the direction of Anthony Bennett. Contributions to the strategy are from Anthony Bennett, Sangita Dubey, Warren T.K. Lee, Beau Damen and Camelia Bucatariu, who were responsible for the conceptualization, development, revision and finalization. The Asian Institute of Technology, Bangkok, Thailand provided external inputs to the initial draft. Additional technical inputs were provided by Susana Siar (FAORAP) and the Regional Strategy was peer-reviewed by Divine Njie (FAO headquarters).

Appreciation is due to the Member Nations and non-state participants who provided feedback to the draft during in the Multi-stakeholder Virtual Consultation that took place from 1 to 2 June 2021, in Bangkok, Thailand.

Administrative and logistic support was provided by Dararat Vibulcharoenkitja and Nuanpan Chaoprakoon (FAORAP), Robert Horn edited the manuscript before publication. Graphic design of the publication was provided by QUO Bangkok.

ABBREVIATIONS AND ACRONYMS

ADS	Agriculture development strategy
ADB	Asian Development Bank
AfDB	African Development Bank
AIT	Asian Institute of Technology
APEC	Asia-Pacific Economic Cooperation
APRC	FAO Regional Conference for Asia and the Pacific
ASEAN	Association of Southeast Asian Nations
CFS	Committee on World Food Security
CLP	Critical loss point
FAO	Food and Agriculture Organization of the United Nations
FLW	Food loss and waste
FSC	Food supply chain
GFLI	Global Food Loss Index
GHG	Greenhouse gas
HLPE	High Level Panel of Experts on Food Security and Nutrition
IFAD	International Fund for Agricultural Development
IFI	International financial institution
IFPRI	International Food Policy Research Institute
IFWC	International Food Waste Coalition
MSW	Municipal solid waste
NDCs	Nationally determined contributions
SAARC	South Asian Association for Regional Cooperation
SCP	Sustainable consumption and production
SDG	Sustainable Development Goal
UNEP	United Nations Environment Programme
UNICEF	United Nations Children's Fund
WBCSD	World Business Council for Sustainable Development
WFP	World Food Programme
WHO	World Health Organization
ZHC	Zero Hunger Challenge

EXECUTIVE SUMMARY

In 2012, the United Nations launched the five pillars of the Zero Hunger Challenge. The Challenge includes a pillar on adapting all food systems to eliminate food loss and waste. In 2015, the United Nations launched the *2030 Agenda for Sustainable Development* with 17 Sustainable Development Goals (SDGs). SDG 12 calls on the global community to “ensure sustainable consumption and production patterns.” It includes SDG target 12.3 to “halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses” by 2030.

In April 2018, the Food and Agriculture Organization of the United Nations (FAO) Member Nations in Asia and the Pacific expressed interest in and requested guidance and technical assistance on reducing food losses and food waste (FLW) at the 34th session of the FAO Regional Conference for Asia and the Pacific (APRC) held in Fiji. In September 2020, during the 35th (virtual) session of the APRC, they highlighted that “improving data collection on FLW is a priority for monitoring progress towards achieving the SDGs,”⁸ and recommended that FAO support climate-smart

investments and reduce post-harvest losses through innovations and digital technologies.

In 2019, FAO released the first global estimates for the Food Loss Index (SDG indicator 12.3.1) stating that 13.8 percent of all food produced in 2016 was lostⁱ from the farm up to, but excluding, the segment of the food chain from retail to households. Regional estimates of FLW range from 5 to 6 percent in Australia and New Zealand to 20 to 21 percent in Central and South Asia.

On the first International Day of Awareness of Food Loss and Waste, 29 September 2020, United Nations Secretary-General António Guterres said that FLW reduction efforts needed to be stepped up. He called for including FLW in climate plans under the Paris Agreement while recognizing that COVID-19 exposed critical weaknesses in food systems.⁹ Total FLW represents nearly a quarter of all the water used in agriculture and is responsible for an estimated 8 percent of annual greenhouse gas emissions. If it were a country, FLW would be the third-largest greenhouse gas emitter after China and the United States of America.

ⁱ Estimates in physical quantities for different commodities and aggregated by an economic weight.



2012

2018

2019

2020

2050

The COVID-19 pandemic caused food demand and supply shocks. Those shocks impacted urban and rural communities in numerous ways, for instance, by placing availability and accessibility in unforeseen circumstances, lowering the quality of diets, and affecting the poor and nutritionally vulnerable groups. During this pandemic, small farmers, fishers, meat and dairy producers in developing countries faced spiked shortages of on-farm labour and gaps in access to harvesting and on-farm processing technologies. These losses and circumstances lead to income loss for all supply chain actors, along with fragmented economic and geographical availability and accessibility of safe and nutritious food for consumers.

The 2020 FAO Regional Conference for Asia and the Pacific recognized FLW as one of the top regional priorities. FLW's impact on productivity is transmitted through food prices. Prevention and reduction of food losses, therefore, have downstream and upstream impacts. Particular attention should be paid to the fact that economic

decisions underlie much of FLW generation, and that quantity and quality measurement needs to improve.

The purpose of the *FAO Regional Strategy on Food Loss and Waste Reduction in Asia and the Pacific* is to raise awareness about food loss and waste, enable and encourage improved data collection and analysis, and facilitate the identification and implementation of state and non-state options for prevention and reduction for improved SDG target 12.3 measurement, monitoring and reporting.

By 2050, population and income growth will drive an increase in overall agricultural outputs and, in particular, food demand could rise by as much as 62 percent, considering climate change impacts.¹⁰ FLW contributes significantly to the rising stress on biodiversity and blue, green and grey water footprints. Persistent FLW levels are an expression of inefficiencies that generate significant economic, social and environmental impacts for the global, regional, national and local food systems. Annual global FLW is estimated to represent nearly a

quarter of all blue water used in agricultural production, around 8 percent of greenhouse gas (GHG) emissions, and approximately USD 940 billion. In 2020, the Intergovernmental Panel on Climate Change (IPCC) issued the “Climate Change and Land” special report in which global FLW was estimated to have caused between 8 and 10 percent of the gas emissions responsible for global warming during 2010 to 2016.

Achieving SDG target 12.3 may reduce the environmental impacts of food systems by up to one-sixth, while climate change adaptation and mitigation measures that integrate FLW prevention and reduction can strengthen multi-sectoral solutions. At the same time, estimates also point to massive amounts of calories and micronutrient and macronutrient losses at the production stage, during post-harvest and consumption because of preventable FLW worldwide.

Improvements in methods of production, conservation and distribution of food are recommended to both reduce FLW and realize the right to adequate food. A sufficient level of awareness is required to reach effective multi-actor and multidisciplinary coordination for significant FLW reduction among small food producers and consumers in Asia and the Pacific. Sustainable, inclusive and resilient regional and local food systems also rely on consumers’ food literacy (adapted to rural and urban dynamics) and food security status.

FLW data quality and availability in national food loss indices need to be improved. Data should

be connected and interpreted in view of human nutrition losses, such as calories, micronutrients and macronutrients; local to national databases on food insecurity (SDG 2) and national food composition tables. Data should be directly connected to SDGs such as SDG 6 (sustainable water management), SDG 11 (sustainable cities and communities), SDG 13 (climate change), SDG 14 (marine resources) and SDG 15 (terrestrial ecosystems, forestry, biodiversity).

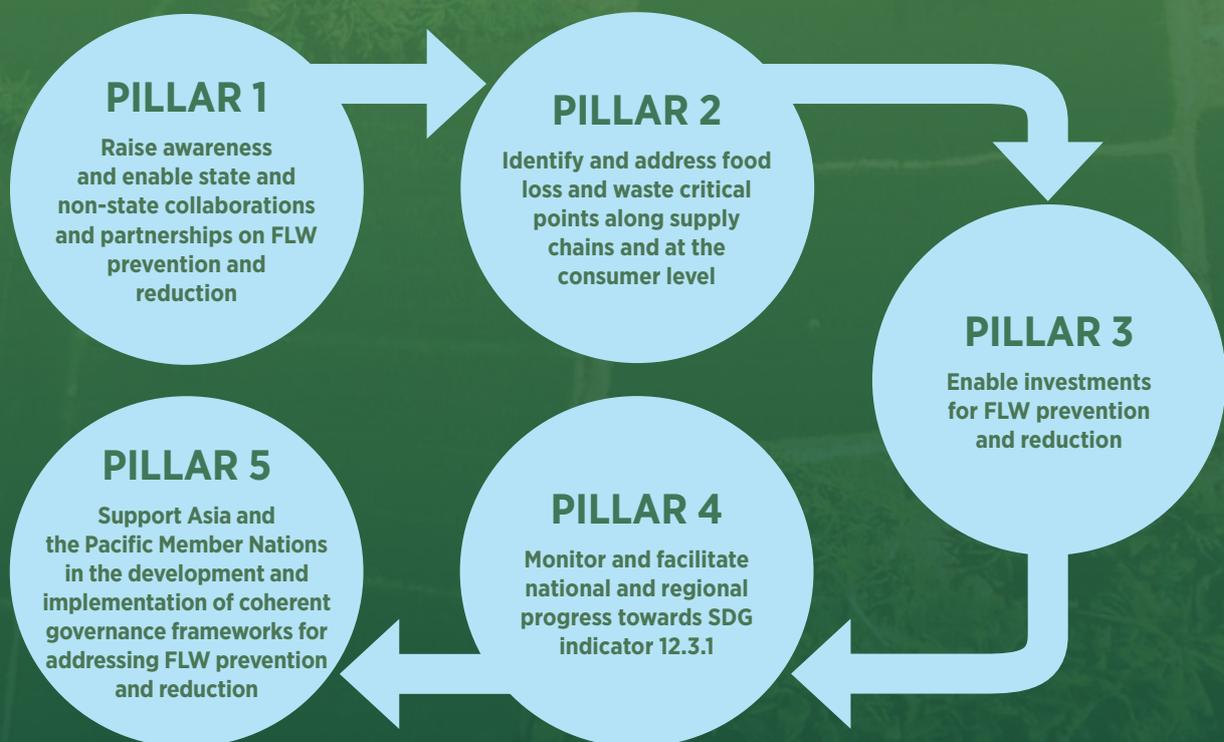
FAO is mandated to support country efforts to monitor and report progress on SDG indicator 12.3.1.a through the Food Loss Index while also providing support for SDG indicator 12.3.1.b the Food Waste Index prepared by the United Nations Environment Programme (UNEP).

In Asia and the Pacific, governments, civil society organizations and some private and financial sector actors have initiatives to address FLW. Approaches to tackle food loss, food waste, or both encompass national strategies as in Australia, China, Japan, Singapore and Thailand. They include local or sector-specific projects from the Asian Development Bank, World Bank, Timor-Leste, India and Palau. Some are private-sector-led innovations from entities such as Rabobank, GreenPod Labs in India, Winnow, and the World Business Council for Sustainable Development. Others address food insecure community support such as Second Harvest Asia, OzHarvest Australia, and the Roti Bank in India. They include household-focused quantification and behaviour change campaigns such as Eat Smart, Save Food in Malaysia, and the Clean Your Plate campaign in China.



© shutterstock/Settawat Udorn

With this background, the FAO is launching the first multi-stakeholder and multidisciplinary *Regional Strategy on Food Loss and Waste Reduction in Asia and the Pacific* to provide Member Nations with context-based support through five key pillars:



To enable action and impact at scale, the *FAO Regional Strategy on Food Loss and Waste Reduction in Asia and the Pacific* underscores the opportunity to address the identified gap in regional coordination, knowledge sharing, and peer-to-peer learning through the Organization's function of convening and knowledge sharing, in addition to policy and technical support for Member Nations.

The development of the strategy was informed by a detailed literature review, past and ongoing FAO activities at the national, regional,ⁱⁱ and global levels, in-depth country studies,ⁱⁱⁱ and validated through a virtual regional consultation involving 19 countries on 1 and 2 June 2021.

FLW socio-economic impacts concern all stakeholders, from the regional to local food systems. For instance, producers' returns on investments are affected at the same time as end consumers' nutritional status, while GHG emissions from food waste (i.e. from retail to households) and from all other supply chain operations impact climate change. State and non-state interventions are needed for achieving impact at scale to prevent and reduce FLW through: coherent food system policies and regulations that directly address or integrate the topic; strategies and business environments that are conducive to short-, medium-, and long-term investments; socio-economic and technological innovations that build and strengthen cross-functional private-public-civil society collaborations, and food literate consumers who can drive food system transformations for healthy and sustainable diets that prevent food waste.

Context-based solutions are important. The Asia-Pacific region is undergoing systemic transformation driven by urbanization, population growth and climate shifts. For FLW solutions to

be adopted, effective and sustainable, they must enable multi-actor and multidisciplinary alignment. Improved availability of safe and nutritious food through prevention and reduction of FLW can contribute to food security and nutrition in the region (FAO, UNICEF, WFP and WHO, 2021).

These intervention areas should be supported by accessible FLW knowledge on relevant local, national and global approaches and results through platforms that facilitate peer-to-peer dialogue and knowledge exchange. Interventions could benefit from an overview on FLW socio-economic and environmental impacts of quantities arising and of identified solutions. For instance, the Paris Agreement nationally determined contributions^{iv} could include a focus on lowering greenhouse gas emissions through food waste reduction at the retail and consumer levels. Intervention areas should also be supported by guidance on monitoring and reporting for the national food loss indices of SDG indicator 12.3.1.a through, FAO e-learning course on the Food Loss Index sub-indicator, the FAO e-learning course on the analysis of food supply chain critical loss points, and the FAO e-learning course on fisheries losses. Lastly, support should be provided through state and non-state actors' consultations on setting, implementing, monitoring and evaluating national, local and sector-focused FLW strategies, action and investment plans.

Food losses also directly impact farmer and food and agriculture value chain livelihoods with less of the food produced entering supply chains. In some cases, farm losses, including harvesting losses, are due to a significant lack of storage, market access or gaps in preservation techniques that limit marketability and ultimately the income for both home-consumed as well as saleable foods.

ⁱⁱ i.e. Africa, Europe and Central Asia, Latin America and the Caribbean, Near East and North Africa

ⁱⁱⁱ e.g. China, Nepal, and Thailand

^{iv} Paris Agreement and nationally determined contributions (NDCs): Article 4.2 "Each Party shall prepare, communicate and maintain successive nationally determined contributions that it intends to achieve. Parties shall pursue domestic mitigation measures, with the aim of achieving the objectives of such contributions."

FOOD LOSS AND FOOD WASTE



1.1. Definitions

The universal 2030 Agenda adopted by the United Nations in 2015 has among its 17 Sustainable Development Goals the sustainable production and consumption SDG 12 with target 12.3: “by 2030, halve per capita global food waste at the retail and consumer levels and reduce FL along production and supply chains, including postharvest losses.”

Monitoring and reporting for SDG target 12.3 is vital to achieving not only SDG 12, but also contributing to the success of other SDGs, such as SDG 2 (zero hunger).^v One key aspect supporting this path is setting a global definition for food loss and waste that can be utilized for prioritizing interventions and generating comparable data sets from the local to global levels.

SDG target 12.3 has two components: food loss and food waste. Each component is measured by a separate indicator mandated to a different custodian United Nations agency.

In 2019, FAO addressed the challenge of establishing the global definition of food loss as measured in SDG indicator 12.3.1.a and food waste as measured in indicator 12.3.1.b. The food loss definition includes the inedible parts of foodstuffs and provides a framework for national statistical reporting.^{vi} SDG indicator 12.3.1.a that tracks food loss is defined as ‘the percentage of food quantities removed from the supply chain.’ The full food loss definition^{vi} adopted for SDG indicator 12.3.1.a is:

^v SDG 6 (sustainable water management), SDG 11 (sustainable cities and communities), SDG 13 (climate change), SDG 14 (marine resources); SDG 15 (terrestrial ecosystems, forestry, biodiversity); SDG 17 (partnerships)).

^{vi} Food diverted to other economic uses, such as animal feed, is not considered as quantitative food loss or waste. Similarly, inedible parts are not considered as food loss or waste. (FAO, 2019).

Food losses are all the crop and livestock human-edible commodity quantities that, directly or indirectly, completely exit the post-harvest/ slaughter production/supply chain by being discarded, incinerated or otherwise, and do not re-enter in any other utilization (such as animal feed, industrial use, etc.), up to, and excluding, the retail level. Losses that occur during storage, transportation and processing, also of imported quantities, are therefore all included. Losses include the commodity as a whole with its non-edible parts.¹²

SDG indicator 12.3.1b tracks progress from the retail to the consumer level, and is technically supported by FAO and led by UNEP. It measures tonnes of wasted food per capita, considering a mixed stream of products from processing to consumption.^{vii}

For the purposes of the Food Waste Index, “food waste” is defined as food and the associated inedible parts removed from the human food supply chain in the following sectors: Retail, Food service, Households “Removed from the human food supply chain” means one of the following end destinations: landfill; controlled combustion; sewer; litter/discards/refuse; co/anaerobic digestion; compost/aerobic digestion; or land application.

Food is defined as any substance – whether processed, semi-processed or raw – that is intended for human consumption. “Food” includes drink, and any substance that has been used in the manufacture, preparation or treatment of food. Therefore, food waste includes both: “edible parts”: i.e., the parts of food that were intended for human consumption, and “inedible parts”: components associated with a food that are not intended to be consumed by humans. Examples of inedible parts associated with food could include bones, rinds, and pits/stones.¹³

The overall conceptual framework for food loss and waste is presented in Figure 1. Definitions are at the basis of measurement that allows tracking progress towards a target. Food losses and food waste have a two-level definitional approach: one definition for

national to global data collection and reporting (i.e. the SDG indicator 12.3.1.a and b indices) and one definition for supply chain level analysis of critical loss and waste points. In the latter case, food loss can either be quantitative or qualitative.^{viii} The FAO *State of Food and Agriculture 2019* report¹⁴ provides the following definitions:

Qualitative food loss and waste refers to the decrease in food attributes that reduces its value in terms of intended use. It can result in reduced nutritional value (e.g. smaller amounts of vitamin C in bruised fruits) and/or the economic value of food because of non-compliance with quality standards. A reduction in quality may result in unsafe food, presenting risks to consumer health.

Qualitative food loss refers to the decrease in food attributes that reduces the value of food in terms of its intended use – it results from decisions and actions by food suppliers in the chain.

Qualitative food waste is the same but results from actions by retailers, food services and consumers.

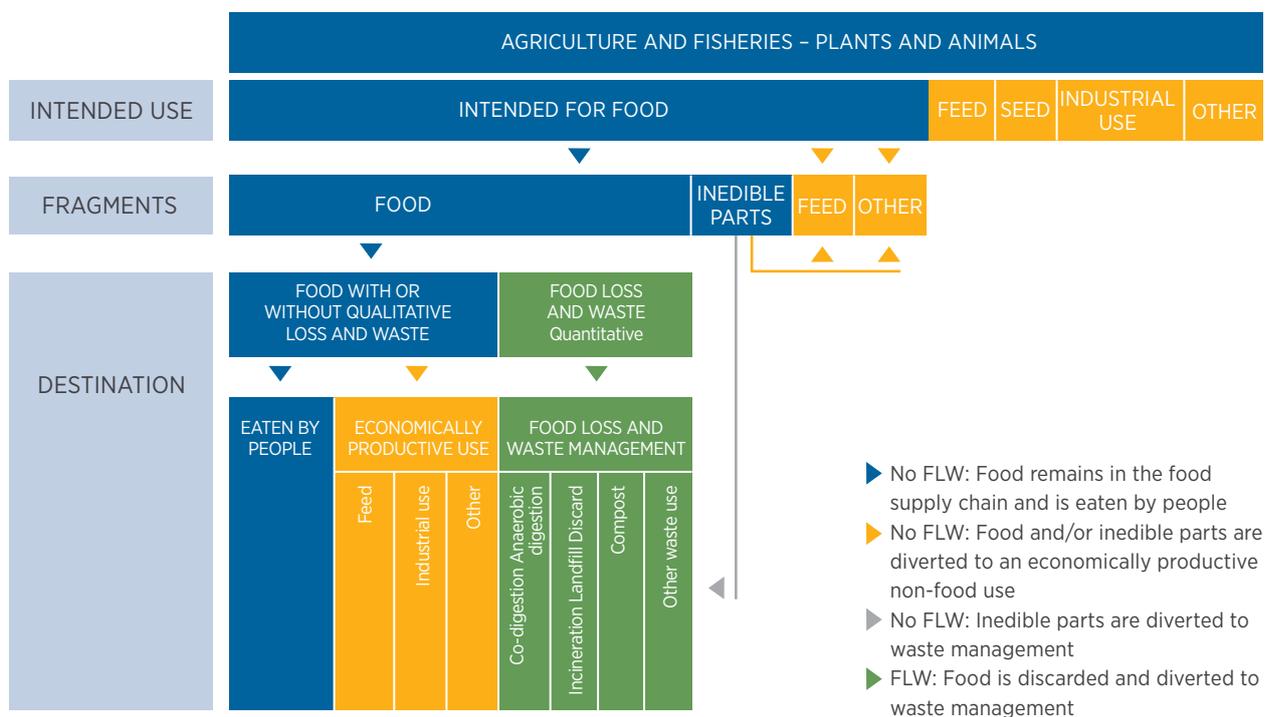


^{vii} The 12.3.1.b Food waste index is divided in: Level I indicators - Food waste in the waste stream that is estimated from a global model, based on regional coefficients for food waste in the total waste stream; and Level II indicators - Food waste generation by supply chain stage that is to collect data on food waste generation from supply chain stages based on national priorities. Available at: https://uneplive.unep.org/indicator/index/12_3_1 (Consulted on 09 November 2020)

^{viii} Not covered in the Food Loss Index (SDG indicator 12.3.1.a)



FIGURE 1:
Conceptual framework for food loss and waste



NOTE: "Industrial use" includes biofuels, fibres for packaging material, creating bioplastics (e.g. polylactic acid), making traditional materials such as leather or feathers (e.g. for pillows) and rendering fat, oil or grease into a raw material to make soaps, biodiesel or cosmetics. It does not include anaerobic digestion, as the latter is intended to manage waste. "Other" includes uses such as fertilizer and ground cover. The length of the bars is not representative of the total volume or value of the products concerned.

SOURCE: FAO, 2019

1.2. Causes

FLW causes are context based and refer to the characteristics of production, manufacturing, storage and marketing systems, and to consumers' food literacy capacity. Micro, meso and macro causes¹⁵ can be linked to food supply chain characteristics, structural issues, or the systemic dimension of the food systems respectively. To prioritize solutions to FLW, causes need to be not only identified, but also analysed and placed in hierarchical order. What is the root cause that should be considered in the prevention and reduction intervention selected for implementation?

Practitioners, researchers and policy makers are currently working on developing knowledge on context-based linkages between causes and levels of food loss and food waste in developed, transitioning and developing nations while assessing the impacts and feasibility of solutions. Throughout the literature on the subject, the causes identified are considered common across nations.

Causes of food losses, from production to the wholesale level, can be actor-specific or systemic. Identified causes include crop damage by insects, rodents, birds; unfavourable or extreme weather;

spillage and damage due to equipment malfunction, faulty cold or cool storage, or inefficiencies during harvesting, drying, milling, processing, transporting, and significant gaps in public roads and infrastructure; out grading of produce due to aesthetic standards¹⁶; agricultural subsidies leading to overproduction of farm crops¹⁷; gaps in food contact materials such as packaging materials and machinery; inadequate infrastructure at aggregation points such as lack of shade for the produce, long waiting times, and market access and infrastructure; lack of investments for local market supply chains versus export supply chains; and lack of awareness on solutions available and cost-benefit analyses to drive action.¹⁸

Correctly identifying causes is essential for a prevention or reduction efforts to be successful. For instance, in 2020, the World Business Council for Sustainable Development (WBCSD) started to work with its member companies to quantify FLW, identify causes and prioritize solutions. Specifically, Portugal's multinational corporation Sonae, which has suppliers of fruits and vegetables worldwide, worked on five pilot projects that, if scaled up, could reportedly cut its loss and waste by one-third,

BOX 1: Timor-Leste: Critical loss points for selected maize value chains

Maize is the most widely consumed commodity in Timor-Leste and is a key determinant of household food security for subsistence farmers, as they consume 85 percent of what they produce. The average national annual production is around 87 000 tonnes and productivity is around 2.1 tonnes per hectare. Only 20 percent of maize is marketed (market value of USD 11.6 million).

The analysis of critical loss points focused on the formal and informal maize supply chains in the districts of Lautem. Results show that losses occur along supply chains – particularly at harvesting, drying and farm storage – with average estimated losses of 5.5 percent, 2.5 percent and 2.5 percent, respectively. The total estimated losses for maize are 15.4 percent of the total annual production of 140.8 tonnes in the study area, which represents an economic loss of USD 9 800, or USD 98 per farmer (selling price: USD 0.45 per kg).

Among identified causes are lack of labour and equipment as well as drying and storage facilities, rain during harvesting, and poor road conditions.

SOURCE: FAO. 2018. Food loss analysis: Causes and solutions – Case study on the maize value chain in the Democratic Republic of Timor-Leste. Rome. 44 pp. Licence: CC BY-NC-SA 3.0 IGO.



or roughly 12 000 tonnes. Sonae estimated the value of that as USD 10 million per year for itself and the companies in its supply chain. This is because about 20 percent of the fruits and vegetables in Sonae's supply chain are lost or wasted before they reach consumers. Another 13 percent is lost in suppliers' operations, and 7 percent in the company's stores. The five pilot projects worked on: product specifications review, a dehydration initiative, market-place setup, a donation programme, and a "too good to waste" campaign.¹⁹

The literature cites several causes of food waste. They include higher food waste levels for low-income consumers who purchase low-quality food that ends up unused or thrown away,^{20, 21} and lower food waste levels for price-oriented quantity purchasing²² or food waste due to high disposable income.²³ Other causes are consumers' confusion about "use-by" and "best before" dates,^{24, 25} and significant levels of inefficiency in catering services for all age groups and different contexts, coupled with rigid food procurement specifications.²⁶

Overall, the literature documents a lack of knowledge or awareness about food waste as an issue. Few are aware of the amount of waste generated, the monetary loss associated with it, the impact of inappropriate portion sizes, and strategies to reduce it.²⁷ Lack of knowledge can affect consumers through insufficient food literacy that does not reconcile available time,

financial resources and food management skills. For instance, gaps in capacity can impact retail selling points through inadequate packaging, temperature and humidity control. It also affects food services, for example through restaurants' surplus preparation.²⁸ The literature cites waste management systems that are overwhelmed and facing challenges to segregate, collect, and utilize food waste. If these challenges were addressed, it would incentivize prevention.²⁹ It would also help prevent or mitigate methane emissions that increase with higher organic and moisture content at disposal sites. Methane emissions are 25 to 72 times more potent than carbon dioxide as a greenhouse gas.

State and non-state actors, including consumers in developing and developed countries, in Asia and the Pacific can have different reasons that drive their actions on FLW prevention and reduction. These can refer to, for instance, reducing environmental impacts, supporting food security through contributions to food access and availability, contributing to their own business model sustainability, increasing productivity, and reducing the pressures for landfilling space and the costs for bio-waste management. Independently of the priority that determines taking action towards minimizing FLW, having an adequate understanding of the quantity and quality that is lost or wasted is a determinant for both resource allocation and for tracking the socio-economic and environmental impacts and results achieved.³⁰

BOX 2: United States of America: Strategy on food loss and waste

Qualitative and quantitative research lead to the identification of causes of food losses and waste. Among these, at the beginning of the food supply chains, there are challenges for drying, milling, transporting, processing, pest damage, moulds and bacteria. Retail food business operators incur waste due to equipment malfunction and miss-alignment between demand and supply. Finally, consumers can generate food waste because of lack of adequate food literacy for planned shopping, portion sizes and use of leftovers.

Once causes were identified, actions were planned and implemented:

In June 2013, the United States of America launched the Food Waste Challenge. The country's Environmental Protection Agency (EPA) estimates that "more food (over 75 billion pounds) reaches landfills and combustion facilities than any other material in everyday trash, constituting 22 percent of discarded municipal solid waste" and that "landfills are the third largest source of human-related methane emissions in the United States." In October 2018, the US Department of Agriculture (USDA), EPA, and Food and Drug Administration (FDA) signed a joint agency formal agreement under the Winning on Reducing Food Waste initiative.

In 2019, the three agencies released a federal strategy with six main areas for action:

1. Enhance interagency coordination.
2. Increase consumer education and outreach efforts.
3. Improve coordination and guidance on food loss and waste measurement.
4. Clarify and communicate information on food safety, food date labels and food donations.
5. Collaborate with private industry to reduce food loss and waste across the supply chain.
6. Encourage food waste reduction by federal agencies in their respective facilities.

Education is a relevant area of action for the United States of America's strategic approach to food waste reduction. Since 2016, the EPA has awarded over USD 338 000 in grants to classroom and youth organization projects on food waste reduction practices. The EPA, USDA and University of Arkansas developed a tool to help schools calculate the amount of food wasted in their cafeterias and share tips on food waste prevention. Several grocery and supermarket chains (e.g. Ahold Delhaize, Kroger, Sprout Farmers Market, Walmart, Wegmans and Weis Markets) are part of the 2030 Champions, a coalition launched by the USDA and the EPA.

SOURCE: US Environmental Protection Agency, 2019. Food Loss and Waste Factsheet.
https://www.epa.gov/sites/production/files/2019-09/documents/epafoodwaste_factsheet_2019-11.pdf
<https://www.rbcgam.com/en/ca/article/food-loss-waste/detail>



1.3. Overview of global, regional and national food loss and waste levels

A meta-analysis of existing FLW measurement literature underscores variations found at the supply chain, commodity group and regional levels. Efforts to have better data availability and quality are highlighted by the fact that “only 39 countries have officially reported data on an annual basis between 1990 and 2017 to FAO”.³¹

In 2019, FAO released the first global estimates for the Food Loss Index, stating that 13.8 percent of all food produced in 2016 was lost^{ix} from the farm through the wholesale levels. Regional estimates range from 5 to 6 percent in Australia and New Zealand to 20 to 21 percent in Central and South Asia.³²

BOX 3: Palau: Food waste separate collection is key to food waste reduction

In 2012, the Pacific Island country Palau had a population of about 17 400, of which approximately 70 percent were living in the state of Koror, the country’s main commercial centre. Food waste is a significant challenge for Palau’s waste management system and the main generators of food waste are households, restaurants, hotels and food-processing companies due to gaps in food management skills that go from individuals’ lack of skills to industry-wide practices.

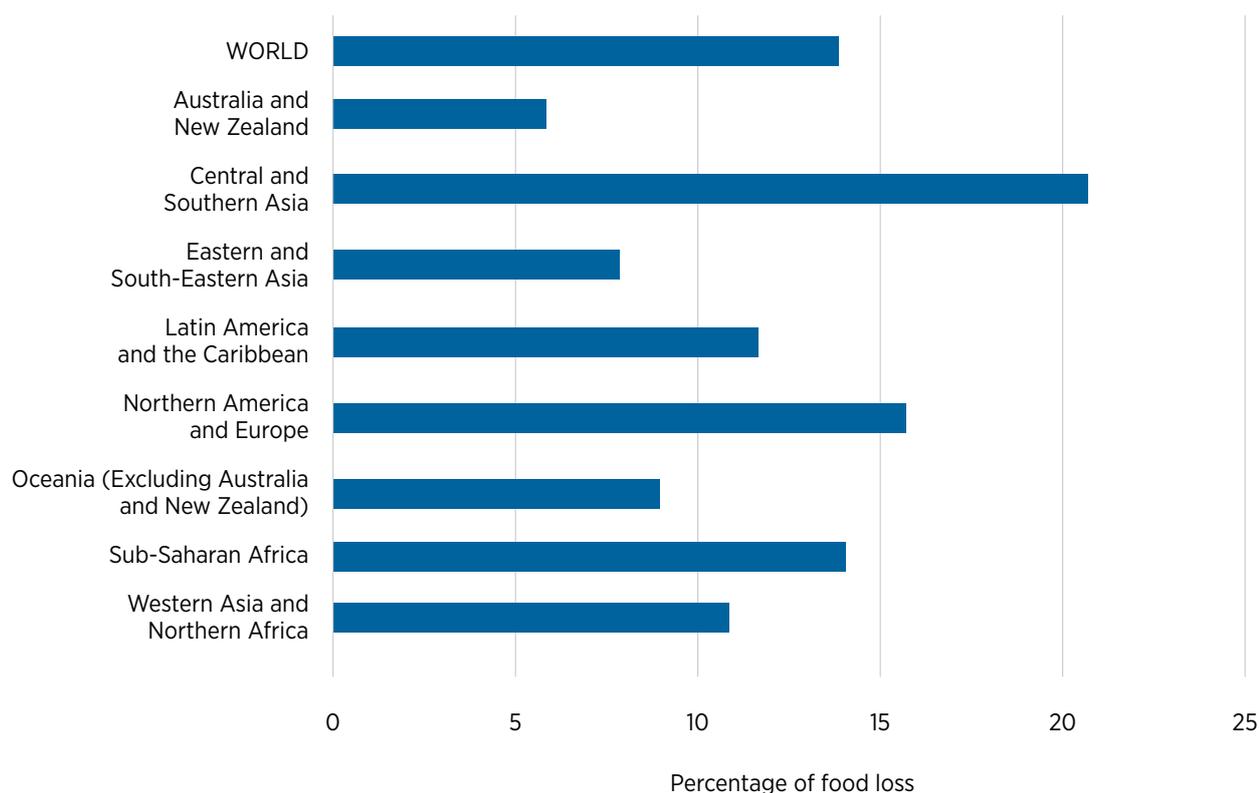
Koror has a collection system that relies on segregation points for households and private sector actors. Biodegradable kitchen waste represents 26 percent of the around 1 369 metric tonnes of solid waste that is generated annually by its households.

Due to its large volume, the government provides composting bins and wood chips for sandwich piling of food waste. The participating households receive free compost every month.

SOURCE: Solid Waste Management in the Pacific. Palau Country Snapshot. Brief. Asian Development Bank, 2014. Available at: <https://www.adb.org/sites/default/files/publication/42665/solid-waste-management-palau.pdf>

^{ix} These estimates are of physical quantities for different commodities aggregated by an economic weight.

FIGURE 2:
Food loss from post-harvest to distribution, global and regional percentages, 2016



NOTE: Percentage of food loss refers to the physical quantity lost for different commodities divided by the amount produced. An economic weight is used to aggregate percentages at regional or commodity group levels, so that higher-value commodities carry more weight in loss estimation than lower-value ones.

SOURCE: FAO, 2019.

The first global estimate of food losses states that East and Southeast Asia on-farm losses range from 0.1 to 18 percent, mainly maize and rice. In Central and South Asia, over 40 percent is lost, mainly pulses, reflecting their high level of consumption relative to other regions where less than 2 percent of losses were pulses.³³

The Food Loss Index adopts the economic value as an accounting measure because it lowers the risk of attributing a higher weight to low-value (e.g. low nutritional value) products just because

they are heavier. However, it is also necessary to identify^{34, x} supply chain critical loss points^{35, xi} for selected commodities, particularly those in the food basket of the target areas, to assess the efficiency and feasibility of a potential intervention, including performing a cost-benefit analysis for its implementation and impacts on consumers' diets. An analysis of critical loss points (Box 4) allows not only the identification of where the highest quantity is lost and the socio-economic impact on the food supply chain actors, but also where investments will have the greatest returns.

^x It is acknowledged that surveys into the extent, location and causes of food loss and waste are complex and costly. (FAO, 2019).

^{xi} Critical loss points are the points along the food supply chain where food losses have the highest magnitude, the greatest impact on food security and the largest economic dimensions. (FAO, 2019).

BOX 4: India: Identification and analysis of critical loss points in selected mango supply chains

Mango provides dietary energy, carbohydrates, fibre, minerals and vitamins. India is the world's leading mango producer with an annual volume of 19.57 million tonnes produced by 76 percent smallholder and marginal farmers.

In 2016, two supply chains were assessed for critical loss points in Andhra Pradesh. Districts of Vizianagaram district were assessed for the fresh fruit and Chittoor district for processed pulp. The assessment found:

- Harvesting, including sorting, results in quantitative loss of 12 percent for the processed and 20 percent for the fresh fruits chain;
- The processed fruit chain has a 20 percent qualitative loss due to decay and uneven fruit ripening;
- Retailing for the fresh fruit chain incurs 5.1 percent quantitative losses and 25 percent qualitative losses due to decay, mechanical damage, and fruit shrivelling due to moisture loss.

Assessment of economic impacts and opportunities: Assuming that 50 percent of the production in Vizianagaram is destined for distant markets, which is equivalent to 183 828 tonnes per year, and a loss rate of 15 percent with traditional packaging, food loss is 79 925 tonnes per year with an economic loss of USD 16 784 334. With the use of plastic crates on a rental basis and with the anticipated loss reduction of 20 percent equivalent to 15 985.08 tonnes per year, the loss reduction savings will be USD 3 356 867. The profitability of using plastic crates amounts to USD 500 562 per year.

SOURCE: FAO, 2018. Food loss analysis: causes and solutions - Case study on the mango value chain in the Republic of India. Rome. 58 pp. Licence: CC BY-NC-SA 3.0 IGO.

FAO 2019 reported between 0 and 15 percent of fruits and vegetables were wasted at the retail level in all regions, except sub-Saharan Africa (35 percent, excluding outliers). Among Asian regions, the median food waste value is the same, but higher variability in percentages for Central and South Asia suggest greater scope for waste reduction.

In 2021, the first UNEP Food Waste Index stated, "around 931 million tonnes of food waste was generated in 2019, 61 percent of which came from households, 26 percent from food service and 13 percent from retail. This suggests that 17 percent of total global food production may be wasted (11 percent in households, 5 percent in food service and 2 percent in retail)".³⁶

APEC FLW data³⁷ (Table 1) shows the seriousness of the issue and highlights significant data and information gaps in the region.



TABLE 1:
Data available on food loss and waste in APEC economies

NO.	COUNTRY	FLW (1 000 TONNE/YEAR)
1	China, Hong Kong SAR	Year 2016 Total: 1 318
2	Japan	Year 2015 <ul style="list-style-type: none"> • Manufacturer: 16 533 • Wholesalers: 2 940 • Retailers: 12 750 • Household: 8 320 • Total: 28 420
3	Malaysia	Year 2016 Rice loss: 205
4	New Zealand	Year 2015 Total: 123
5	Peru	Year 2017 <ul style="list-style-type: none"> • Potato: 16% producers, 1% marketers, 6.1% transformers
6	Philippines	Year 2013 <ul style="list-style-type: none"> • 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: Rice: 689 704 tonnes
7	Singapore	Year 2017 <ul style="list-style-type: none"> • Total: 809.8 tonnes • Households: 336 tonnes
8	Viet Nam	Year 2018 (Fruits and Vegetables): <ul style="list-style-type: none"> • 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 tonnes

SOURCE: APEC, 2018.

Country-level focused actions can generate significant improvements in understanding behaviour drivers for prevention and reduction of

food waste while also contributing to better data, as seen in the example of China, where the Clean Plate Campaign was launched in 2013.

BOX 5: China: Prevention and reduction of food waste by consumers as change agents

In 2015, China generated approximately 17 to 18 million tonnes of urban food waste.³⁸ FLW causes excessive carbon emissions: 152 g CO₂ eq. per person per day in China with 315 g CO₂ eq. in high-income areas.³⁹ In 2013, the country launched the national Clean Plate Campaign targeting food waste reduction by consumers in out-of-home and at-home consumption. The government initiative significantly enabled behaviour change for food systems actors as well as consumers.

A study by Tsai, Chen and Yang⁴⁰ focused on food waste by end consumers, in this case a group of 368 university students, of which 179, or 48.6 percent, were male, and 189, or 51.4 percent, were female. The study explored factors that enable minimization. The results pointed towards three main drivers for food waste reduction and prevention: environmental concerns, subjective norms, and perceived behavioural control.

“Most of the respondents chose university canteens (72.0 percent) and take-out (60.9 percent), while only 58 (15.8 percent) chose to eat in a restaurant. Respondents had little (58.1 percent) or nearly no leftovers (23.9 percent), and only about 18 percent of the respondents produced a lot of leftovers. Regarding the disposal of leftover food, 323 people (87.8 percent) chose to throw it in the trash, 55 (14.9 percent) chose to keep it for their next meal, 41 (11.1 percent) chose to use leftovers as food for pets or stray animals, and 59 (16.0 percent) chose other. In addition, 258 people (70.1 percent) felt guilty when they threw away food, 81 people (22.0 percent) only felt a little guilty, 14 people hardly minded (3.8 percent), and 15 (4.1 percent) did not mind at all. Most of the respondents were concerned about leftovers and cherishing food.”

Conclusions of this research, as well as messages from the Clean Plate Campaign, indicate that more support is needed from media for a shift in consumer behaviour on food waste generation for out-of-house and in-house consumption.

Additionally, in 2014, the Government of China took several steps towards FLW reduction. The Central Committee and State Council issued a joint circular on “Practicing strict economy and fighting against waste.” The State Administration of Grain, the Ministry of Industry and Information Technology, and the General Administration of Quality Supervision, Inspection and Quarantine issued a notice on “Saving food and reducing food losses among foodstuffs and oil-processing industries.”

1.4. Food security and socio-economic impacts along food supply chains and for consumers

It makes economic and social sense to invest in FLW minimization⁴¹ because of the returns.⁴² It is imperative to invest as FLW unnecessarily generates GHG emissions that fuel climate change^{43, 44} in developed as well as developing nations. Global climate change impacts, exacerbated by FLW GHG contributions, are already influencing the rural-to-urban demand-supply dynamics along with stressors such as water quality and availability, and biodiversity loss.

FLW lowers productivity, and that is transmitted through food prices. Therefore, prevention and reduction of food losses have downstream and upstream impacts.⁴⁵ Particular attention should be paid to the fact that economic decisions underlie much of FLW and that measurement needs to improve and should account for both quantity and quality losses.⁴⁶ Leveraging social and technological innovation^{xii} for food and agriculture in Asia and the Pacific – focused on FLW prevention and reduction – is of paramount importance to scale up solutions that can drive systemic changes.

FLW and climate change affect diversity of diets^{47, xiii} and food production. Diversity is also crucial for combating food insecurity and malnutrition, and ensuring food systems resilience. Reducing global FLW by 25 percent would reduce the food-calorie gap by 12 percent, the land-use gap by 27 percent, and the GHG-mitigation gap by 15 percent. Addressing climate change is a priority for Asia and the Pacific. Chapter 3 offers an in-depth analysis of FLW environmental and climate impacts.

On the first International Day of Awareness of Food Loss and Waste, 29 September 2020, UN Secretary-General António Guterres said that we need to step up our efforts on FLW, and that climate plans under the Paris Agreement need to include FLW. In addition, he said that we need to raise awareness about how the COVID-19

emergency increased the fragility of our food systems.

Distributional outcomes, such as farmers' income and interventions in improved storage as well as technologies for increased harvesting efficiency, have a significant impact in reducing losses and making a direct contribution to improving food security for smallholders.⁴⁸ Prevention of FLW connects producers with other actors in the food supply chain in a shared responsibility for minimizing the risk FLW being transmitted from one segment to another.

From a gender perspective, it must be recognized that women as a group play an important role in the food system and as individuals are impacted by malnutrition. FAO found that women face significant constraints in accessing training and membership in producers' organizations, finances and markets – all areas that enable FLW minimization. "A significant gap in data on interventions for women's nutrition and failure to adequately address nulliparous [childless] and elderly women, adolescents and pre-conception individuals is a gap that contributes to transmitting, from generation to generation, the interrelation and compounding nature of nutritional disadvantages."⁴⁹

This evidence should also be considered in the context of the 2019 joint statement by FAO, IFAD, UNICEF, WFP and WHO that, if the current nutritional trends continue, "we will meet neither the 2030 SDG target to halve the number of stunted children nor the 2025 World Health Assembly target to reduce the prevalence of low birth weight by 30 percent." Maximizing social welfare is a challenge, given that markets often fail in their resource allocations due to difficulties faced at the policy level because of a lack of coherence or resistance to implementing an environmental accounting approach to food consumption and production.⁵⁰

^{xii} FAO (2020) defines agricultural innovation as: the process whereby new or existing products, processes or ways of organization are used for the first time in a specific context in order to increase their effectiveness, competitiveness and resilience with the goal of contributing towards food security and nutrition, economic development, and sustainable natural resource management. See <http://www.fao.org/asiapacific/perspectives/innovations/en/>

^{xiii} "Dietary diversity is a qualitative measure of food consumption that reflects household access to a variety of foods, and is also a proxy for nutrient adequacy of the diet of individuals."

FLW prevention and reduction can increase food availability for consumers. However, low-, middle- and high-income countries should also integrate access into their FLW interventions.⁵¹ Achieving SDG target 12.3, coupled with pathways for improving nutrition would contribute to achieving SDG target 2.1 (end hunger and ensure access) and 2.2 (reduce malnutrition). For instance, some of the highest degrees of reported losses occur at the farm level in developing countries. This has significant impacts on food availability; particularly in smallholder food systems where producer households consume much of the food they grow or produce, such as cereals, and market any excess. Increasing the volume of food for the household could provide better incomes if there is an available market for the additional food produced.

Interventions concerning the prevention and reduction of food waste, which typically takes place at the retail to household segments of the food chain, impact the overall economic efficiency of the supply chain. Interventions can reduce (bio)

waste management costs borne by the private sector, public sector and environment. They can also contribute to an increase in the budget of households. Yu and Jaenicke⁵² found that food waste can be considered as a household input inefficiency. Literature highlights that the validity of the previously considered theory that developing countries have less food waste than developed nations is quickly diminishing. A 2020 study by Liu and Nguyen found that in 2012 in Viet Nam's capital Hanoi food waste accounted for 53.8 percent (3 149 723 tonnes) of municipal solid waste. Economies such as those in China and South Asia are likely to play a key role in determining global food waste at mid-century.⁵³

Reducing food loss earlier in the supply chain is often most beneficial in terms of food availability for food security and can benefit small food producers. Investments for broader infrastructure, such as reliable electricity or cold storage, can reduce losses along supply chains, even if this was not the objective of the investments.⁵⁴

BOX 6: International Fund for Agricultural Development (IFAD): Grant portfolio for food loss prevention with a focus on small food producers

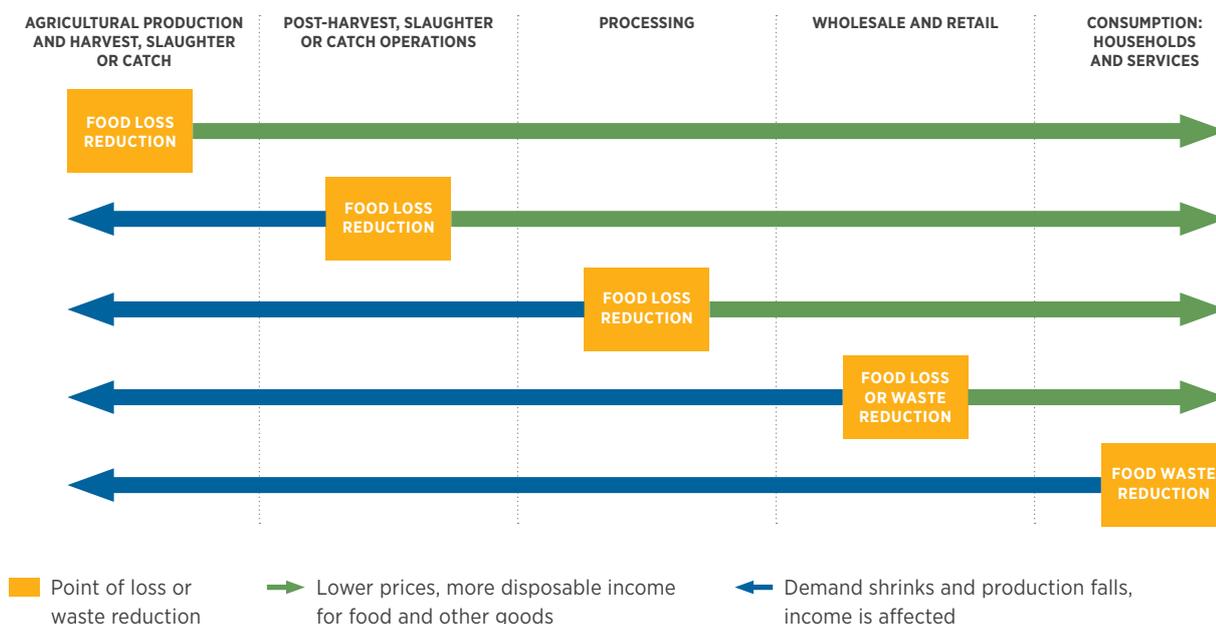
From 2012 to 2020, IFAD had a total grant portfolio of USD 3 175 824 focused on small food producers in developing countries. Implementation partners included the United Kingdom of Great Britain and Northern Ireland Department for International Development, Irish Government, Irish Aid, FAO, Swiss Agency for Development and Cooperation, the World Food Programme and Rockefeller Foundation.

The interventions focused on mango, sorghum, maize, rice, teff, tomato, cowpea, groundnut, beans and sunflower. Using the FAO Food Loss Analysis methodology, different grain value chains were assessed in five African countries and Timor-Leste. Technologies were piloted in Burkina Faso, Democratic Republic of the Congo, Ethiopia, Malawi, Rwanda and Uganda in Africa and Timor-Leste. Supplementary-funded grants funded solutions piloted in six African countries and Timor-Leste, reaching 11 000 farmers, traders and processors.

The lack of access to affordable finance is a key constraint preventing small-scale farmers' groups from investing in technologies that reduce food losses. For instance, in Rwanda, farmers who used tarpaulins for drying and hermetic bags for household storage reduced maize losses from 18 percent to 4 percent. This saved a yearly average of 128 kg of maize per household, which equates to two months of additional food for a family of six or USD 79 of extra income.

IFAD. 2020. A decade of food loss reduction: Overview of IFAD's supplementary-funded grant portfolio on food loss reduction.

FIGURE 3:
Potential price and income effects of food loss and waste reduction at various points in the food supply chain



SOURCE: FAO, 2019.

1.4.1. Hidden nutrient losses due to FLW along supply chains – implications for healthy diets and nutrition

FLW is generally measured in weight. Some studies have also used caloric metrics, and other use economic units. Food quality loss or waste (FQLW) is more difficult to assess, as there are different quality and nutritional attributes that may or may not be correlated. FLW measured in mass does not fully consider the nutritional dimensions. Food quantity might be preserved, but this does not necessarily mean that micro and macronutrients are equally preserved.^{55, 56} As food travels from producers to consumers, losses of nutrients take place through handling, processing and storage.

Understanding how nutrient concentrations in food vary with different handling processes, storage conditions and hot spots in the food chain where hidden nutrient losses occur would help improve food handling, processing and storage procedures, thereby maximizing the nutritional quality of food. Research related to FLW and nutrients can be further guided by the definitions of sustainable

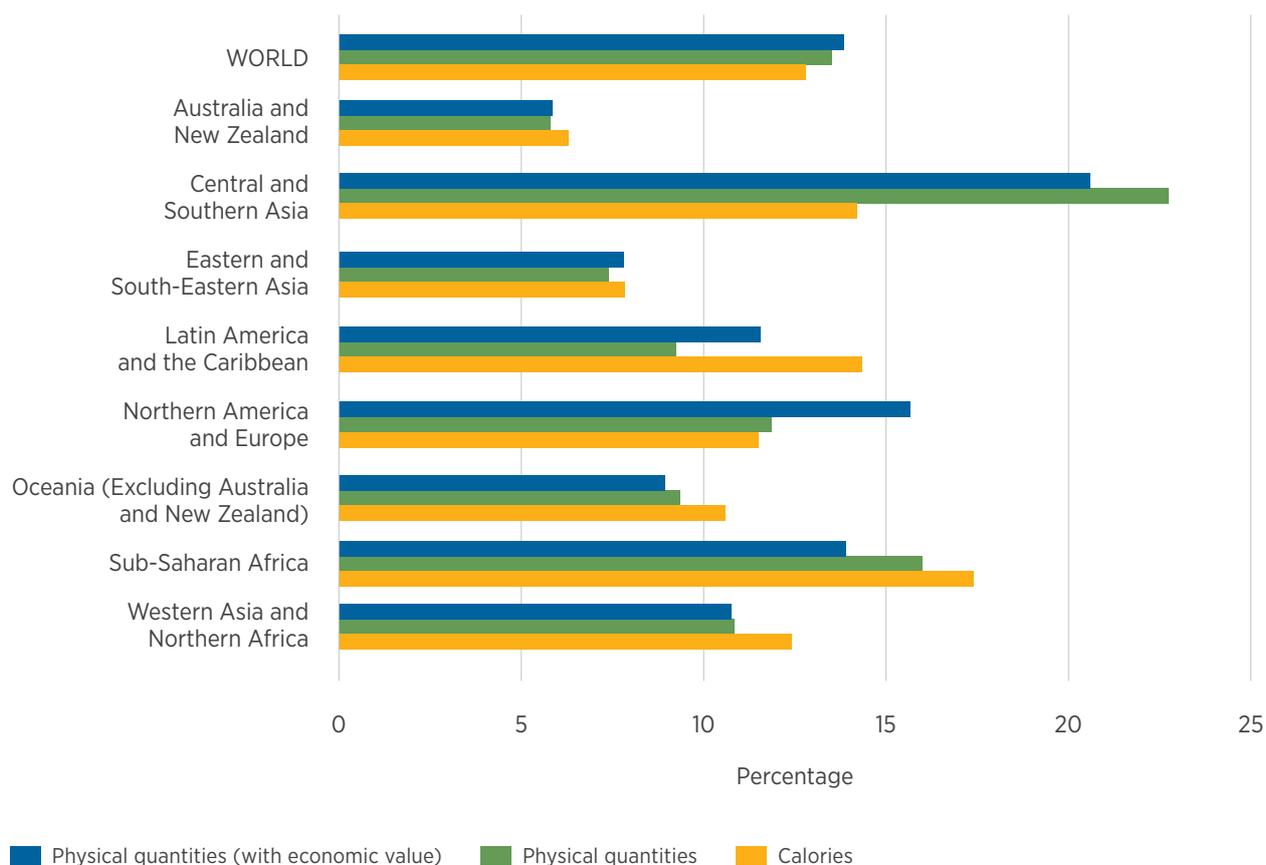
and healthy diets⁵⁷ and nutrition security⁵⁸ that encompass human health and wellbeing as well as planetary health.

Sustainable healthy diets are dietary patterns that promote all dimensions of individuals’ health and wellbeing; have low environmental pressure and impact; are accessible, affordable, safe and equitable; and are culturally acceptable”.⁵⁹

Nutrition security is a situation that exists when secure access to an appropriately nutritious diet is coupled with a sanitary environment and adequate health services and care to ensure a healthy and active life for all household members. Nutrition security differs from food security in that it also considers the aspects of adequate caregiving practices, health and hygiene, in addition to dietary adequacy.⁶⁰

Two recent FAO studies indicated that micronutrient losses from preventable FLW along the food supply chains are alarmingly high.^{61, 62} The first study was on loss and waste of vitamins A and C in fruit and vegetable supply chains in seven regions of the world.⁶³ Massive amounts of vitamins disappeared on the farm, during post-harvest and at the point of consumption. In contrast, food

FIGURE 4:
Food loss percentages in different metrics, global and regional levels, 2016 baseline



SOURCE: FAO, 2019.

processing accounted for the least nutrient loss. Overall, high-income countries in Asia (Japan, China and the Republic of Korea) had the highest overall per capita loss and waste in vitamins A and C (vitamin A: 784 μg RE/person/day and vitamin C: 90 mg/person/day), and the lowest were found in sub-Saharan Africa (vitamin A: 135 μg retinol equivalent [RE] /person/day; vitamin C: 26 mg/person/day) given the weight that grains had in the dataset for this region.

High-income countries in Asia, North America and Oceania had the highest per capita vitamins A and C loss and waste in agricultural production (vitamin A: 228 μg RE/person/day; vitamin C 33 mg/person/day). At the consumer level, waste of vitamins A and C in fruits and vegetables was highest in Japan, China and the Republic of Korea, and lowest in sub-Saharan Africa. In 2018, the Global Panel on Agriculture and Food Systems for Nutrition published a set of policy recommendations on preventing nutrient loss and waste within food systems.

The High Level Panel of Experts on Food Security and Nutrition of the UN Committee on World Food Security⁶⁴ recognized that there is a knowledge gap on the nutritional aspects of food loss and waste. Availability of these analytical data would help inform data-driven food system policies and programmes to reduce FLW and its associated nutrient losses, and to advocate for sustainable food-consumption and production patterns.

In view of a lack of guidance at the country and sub-national levels on estimates of the volume of micronutrient losses from foods during post-harvest loss, FAO developed a standardized methodology based on case studies in Kenya, Cameroon and India. The studies aimed to investigate the link between food loss; nutrient loss of iron, zinc, vitamin A and C due to the analysed food losses; and the prevalence of micronutrient deficiencies among children under 5 years of age in these three countries.

BOX 7: Global Panel on Agriculture and Food Systems for Nutrition: Priority areas of action to prevent loss and waste of nutrients

Loss and waste affects the availability and affordability of foods that make up healthy diets. The threats of micronutrient deficiencies, undernutrition and obesogenic diets pose a serious challenge to policymakers, not only in terms of the health, learning capacity and productivity of people, but also in relation to mounting healthcare costs associated with poor diet quality.

Reducing the loss and waste of nutrients through prevention of FLW would help reduce hunger and malnutrition. The identified priority areas are:

- Educate food systems stakeholders to prioritize FLW reduction
- Take practical steps for nutrient retention within the food system
- Improve public and private infrastructure for well-functioning and efficient food systems
- Encourage innovative solutions to protect nutrients
- Close the data gap by improving data collection and analysis

SOURCE: Global Panel on Agriculture and Food Systems for Nutrition, 2018.

Results showed that total vitamin A loss from selected food supply chains (FSCs) in Kenya (i.e. banana plantain, banana dessert, maize and milk) reached $1.13 \times 10^{11} \mu\text{g RE}$, mainly from milk and banana dessert FSCs. The total percentage of children in Kenya that could be satisfied in their daily requirement for vitamin A was estimated at 21 percent. Percentages of all children under 5 years of age in Kenya that can theoretically be satisfied by iron, zinc and vitamin C losses from analysed losses were 24 percent, 8 percent and 33 percent, respectively.

Total vitamin A losses from selected FSCs in Cameroon (i.e. fresh tomato, cassava stick, gari meal and fresh potato) were estimated to be $6.51 \times 10^{10} \mu\text{g RE}$, mainly from the fresh tomato FSC. The total percentage of vitamin A deficient children in Cameroon that could be satisfied in their daily requirement for vitamin A was 25 percent. Percentages of children under 5 years of age in Cameroon that can theoretically be satisfied by iron, zinc and vitamin C analysed losses, were 15 percent, 12 percent and 83 percent, respectively.

Total vitamin A loss from selected Indian FSCs (i.e. fresh chickpeas, rice, milk and mango) was

estimated to be $1.76 \times 10^{12} \mu\text{g RE}$, mainly from mango. Total percentage of vitamin A deficient children in India that could be satisfied in their daily requirement for vitamin A by the estimated loss is 21 percent. Percentages of children under 5 years of age in India that can theoretically be satisfied by iron, zinc and vitamin C losses from different FSCs in selected regions of India, were 2 percent, 2 percent and 23 percent, respectively.

The study demonstrates that the scale of preventable post-harvest micronutrient losses of foods is phenomenal and would be even higher if additional food supply chains in the three countries were considered. It warrants the incorporation of a nutrition perspective in any future interventions on the prevention and reduction of FLW. There is an urgent need to strengthen country- and regional-level data collection on FLW for nutrient-rich foods to provide evidence for recommendations to stakeholders and decision-makers on designing nutrition-sensitive interventions aiming at reducing post-harvest micronutrient losses due to FLW.

In low- and middle-income countries, a considerable amount of food loss is estimated to occur after food leaves the farm and before

it reaches the point of retail sale.⁶⁵ Considering that food losses in domestic food supply chains subtract directly from the total food availability for the population already facing significant dietary challenges, lower-middle-income Nigeria and upper-middle-income

Indonesia participated in the Postharvest Loss Alliance for Nutrition (PLAN) of the Global Alliance for Improved Nutrition (GAIN) to address both reduction of food loss – tomato and fish respectively – and nutrition improvements, particularly for children and women.

BOX 8: Nigeria and Indonesia: Reducing post-harvest loss and improving nutrition

The Geneva-based Global Alliance for Improved Nutrition (GAIN) developed the Postharvest Loss Alliance for Nutrition (PLAN) initiative, which works on global and national alliances of public and private sector actors to address FLW. From 2015 to 2019, PLAN worked in Nigeria (N-PLAN) on the domestic tomato value chain and, from 2018 to 2020, in Indonesia (I-PLAN) on the domestic fish value chain.

Nigeria: Around 30 percent of children under the age of 5 are vitamin A deficient. Only 21 percent of children aged 6 to 24 months and 55 percent of women aged 15 to 49 eat a diet that meets the threshold for minimum diversity, a proxy for micronutrient adequacy. The country is the 16th largest producer of tomatoes, which are a source of vitamins A, C and antioxidants. The domestic tomato supply chain is not optimized, and in 2015 tomato loss was estimated at around 40 to 50 percent, mostly during crating and transport.

As a means of addressing the identified gaps at the supply chain level, and identifying socio-economic and technical options to prevent and reduce food losses, the N-PLAN focused on alliance and platform building across different actors (both formal and informal connections) and a Business-to-Business Engine. It reached 354 businesses: traders, growers, aggregators, distributors, government representatives, banks and local universities. The Business-to-Business Engine matched 15 Nigerian businesses with international and national industry experts for one-on-one technical assistance. N-PLAN is being taken forward by the Organization for Technology Advancement of Cold Chain in West Africa (OTACCWA), an independent organization.

Indonesia: Fish is a source of protein, healthy fats, and essential nutrients such as omega-3 fatty acids, iodine, vitamin D and calcium. Omega-3 fatty acids are particularly beneficial for pregnant women and young children. Current inadequacies in many Indonesian diets could be reduced through an increase in fish consumption: only about half of Indonesian children aged 6 to 23 months eat a minimally diverse diet, and 31 percent of children under the age of 5 years are stunted.

Fish loss reduction was targeted by I-PLAN through alliance and platform building across fish supply chains through training, capacity building, facilitating access to finance, and engaging government. It was also targeted through a Business Innovation Challenge for local innovations such as cold chain technologies, and for food safety and quality. I-PLAN worked in collaboration with Indonesia's Ministry of Maritime Affairs District Fisheries Offices. In 2020 I-PLAN had reached 305 business members, 28 non-business members, and received over 250 innovation applicants.

In Indonesia, businesses reported adopting cold chain technologies, and in Nigeria reported using reusable plastic crates, instead of baskets, for tomato transport, both as results of the PLAN initiatives.

SOURCE: GAIN Working Paper No. 9. Creating alliances and fostering innovations to reduce post-harvest loss of nutritious food experiences from the Postharvest Loss Alliance for Nutrition (PLAN). Available at: <https://www.gainhealth.org/sites/default/files/publications/documents/gain-working-paper-series-9-creating-alliances-and-fostering-innovations-to-reduce-post-harvest-loss-of-nutritious-food.pdf>

1.5. Sustainable Development Goal target 12.3 and indicators

SDG target 12.3 contributes to the overarching SDG 12 on sustainable production and consumption. The aim of SDG target 12.3 is to “halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses,” by 2030. This target’s indicator 12.3.1 has two components, food losses and food waste, which are measured using two separate sub-indicators (12.3.1.a and 12.3.1.b), one focusing on the ‘*reduction of losses along the food production and supply chains*’ (supply side) and the second to measure ‘*halving per capita global food waste at the retail and consumer level*’ (demand side).

Sub-indicator 12.3.1.a – Food Loss Index

This sub-indicator focuses on food losses that occur from production up to (and not including) the retail level. It measures the changes in percentage loss for a basket of at least 10 main commodities across five key food groups (minimum of two commodities per food group) including cereals and pulses, fruit and vegetables, roots, tubers and oil-bearing crops, animal products, fish and fish products by country in comparison with a base period. A sixth group can optionally be included and may contain sugar, spices or any crops that are considered important by the country. Improved food loss and waste measurements, monitoring and reporting contribute to tracking progress towards SDG target 12.3. The FAO is the custodian for sub-indicator 12.3.1.a. In that role, FAO held consultations to establish a global methodology, provided capacity development and technical assistance to countries to collect data, compile and report the indicator, and consulted with stakeholders to understand and use the results for evidence-based decision making at the policy level and for advocacy.

The Food Loss Index measures change in food losses along the supply chain from the point of maturity on the harvesting/catch/slaughter production site to the retail level. The objective is to show the impact of policy and investment on the efficiency of the supply chain. FAO recommends collecting data to tailor programmes that improve the efficiency and functioning of food supply chains and addressing FLW in the context of other policy priorities, such as education, nutrition, economic and environmental policies.⁶⁶

Since 2018, the Food Loss Index has been a Tier II Indicator, meaning that the methodology has been internationally endorsed and is available for use by Member Nations. The main challenge is not in the calculation of the index per se, but in identifying the supply chains’ critical loss points, obtaining data to calculate the loss percentages for these various stages of the supply chains, and in aggregating them into national loss points for a commodity Food Loss Percentage. To do that, countries need guidelines on how to cost-effectively collect, estimate and aggregate losses at the farm, transport, storage, industry and wholesale stages, and on how to combine data sources and prioritize efforts. FAO has developed a two-pronged approach to address data scarcity by providing Member Nations with a loss imputation model that can be adapted at the national level based on outlined boundaries.

The first prong is a complete methodological and technical assistance package with a set of guidelines and training material on loss data collection and estimation, supported by capacity development and technical assistance in implementing the guidelines. The second prong is a loss imputation model to estimate losses in the absence of measured data. The imputation model was developed first for estimating losses internationally using the few loss estimates in the Food Balance Sheets reported by countries and factors found in the specialized literature.

Sub-indicator 12.3.1.b – Food Waste Index

The methodology for sub-indicator 12.3.1.b targets food waste from retail to consumption. UNEP is the custodian agency for this sub-indicator with FAO in a supporting role as co-custodian. The approach to sub-indicator 12.3.1.b has three levels. Level 1 is estimated by calculations using World Bank ‘What a Waste 2.0’ Municipal Solid Waste (MSW) data in tonnes per year and the organic-food fraction of this. Countries are encouraged to separate ‘food waste’ rather than organic (food plus green waste) when conducting regular waste composition analyses of MSW, and report the food waste fraction of MSW as a first step in tracking progress on SDG indicator 12.3.1.b. For *Level 2* (food waste studies) and *Level 3* (country measurements)

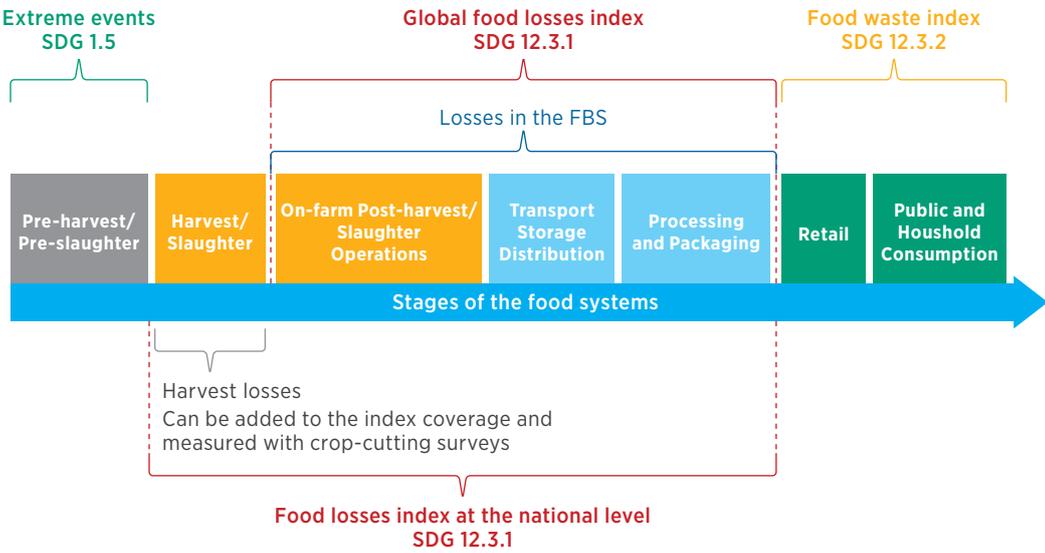
UNEP identified methodologies that can be employed. For households these include waste compositional analysis, direct measurement, diaries (for sewer and home composting) and mass balance (under certain conditions). For retail they include waste compositional analysis, direct measurement, counting/scanning, mass balance (under certain conditions), interviews and surveys. UNEP published the first global estimates in 2021. They highlighted “that household food waste per capita is similar across high-income, upper middle-income and lower-middle income countries, with insufficient data to make conclusions on low-income countries.”

Boundaries of sub-indicators 12.3.1.a (Food Loss Index) and 12.3.1.b (Food Waste Index)

As explained, the loss indicator will cover losses from the farm through the processing and packaging phase, waste indicator covers food waste from retail to consumption (Figure 5). The food losses and food waste sub-indicators should, therefore, inform policies that can improve the efficiency of value chains, change the behaviours of various actors, and encourage a better use of food products, co-products and by-products. The two sub-indicators aim to monitor and report on food losses and waste while acknowledging that reducing them to zero is not feasible.



FIGURE 5: SDG indicator 12.3.1 operational boundaries of food supply chains



1.5.1. Global Food Loss Index

To monitor progress towards SDG target 12.3, FAO has developed the Global Food Loss Index (GFLI) methodology. The purpose of the GFLI is to enable policy-makers to look at positive and negative trends in food loss over time, with a base year of 2015, averaged from 2014 through 2016. The GFLI is the weighted aggregation of country-level Food Loss Indices. While the aggregated index is relevant for global and international monitoring and reporting, countries will likely gain the most value from the national and disaggregated Food Loss Index at the sub-national level, for instance, by geographic area or agro-ecological zone, food loss percentages along points of the value chain and distributive economic sectors at each stage. Therefore, decision-makers could also consider how country-level Food Loss Indices data collection can be supported by data points generated through the FAO Case study methodology for the analysis of critical food loss points (Annex 2).

1.5.2. National Food Loss Index and food loss percentage calculations

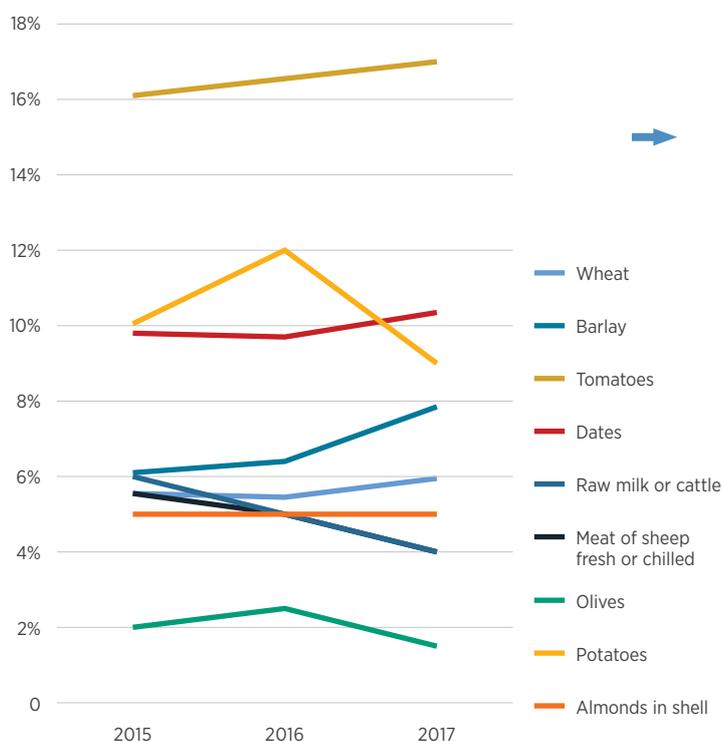
The Food Loss Index has a traditional fixed-base formula comparing percentage losses of a country (i) in the current period (t) to percentage losses in the base period (t₀) for a basket of commodities, using value of production plus imports (q_{ijt0} * p_{jt0}) in the base period as the weights. The index is a composite of commodities (j) that are key in national agricultural production or food systems, including crops, livestock, and fisheries. It tracks losses as a percentage of total supply (l_{ijt}), in order to exclude the impact of production variability.

$$FLI_{it} = \frac{\sum_j l_{ijt} * (q_{ijt0} * p_{jt0})}{\sum_j l_{ij0} * (q_{ij0} * p_{jt0})} * 100$$

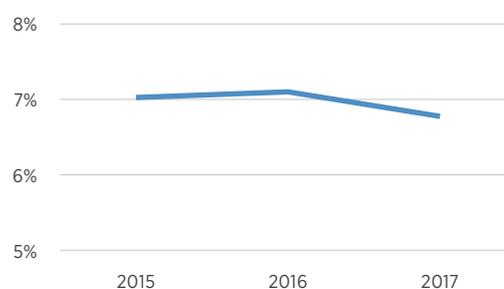
Detailed steps for the compilation of the Food Loss Index are provided in Annex 1 with links to more detailed guidance documents from the FAO Statistics Division. Figure 6 is an example of how a country's National Food Loss Index could look.

FIGURE 6:
Example of compiling, monitoring and reporting for a national Food Loss Index

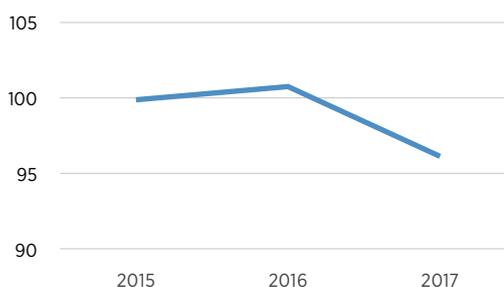
Commodity food loss percentage L_{ijt} (Whole supply chain) for the selected commodities



Country food loss percentage for all selected commodities (FLP_{it}) (weighting applied)



Country food loss index (FLI_{it}) (base year applied)



1.6. Global food losses and food waste policy setting

On 29 September 2020, the first International Day of Awareness of Food Loss and Waste, the UN Secretary-General António Guterres said that FLW prevention and reduction efforts need to be strengthened in a world that produces enough food but that still has millions of food-insecure people. Policy actions and business plans could include FLW prevention and reduction under the Paris Agreement commitments, while also addressing the challenges that the COVID-19 emergency exposed to our food systems.

Recommendations issued at the 2020 FAO Conference for Asia and the Pacific included that FAO “Support Member Nations to improve mechanization, commercialization, diversification and climate-smart investments, reduce post-harvest losses and ease labour constraints, which will be reinforced by innovations, digital technologies and transformation in food systems.”⁶⁷ Moreover, it was suggested at the conference that FAO leverage the Hand-in-Hand Initiative to strengthen FAO country support to achieve priority objectives, especially for responding to the COVID-19 pandemic and associated impacts,⁶⁸ therefore, including FLW.

The COVID-19 pandemic caused food demand and supply shocks, put availability and accessibility in unforeseen circumstances, impacted diet quality⁶⁹ and “disproportionately affected the poor and nutritionally vulnerable groups”. During this pandemic, small food producers in developing countries faced spiked shortages of on-farm labour and gaps in access to harvesting and on-farm processing technologies.⁷⁰

These circumstances lead to income shortages for all supply chain actors, coupled with fragmented availability and accessibility of safe and nutritious food for consumers.

The COVID-19 pandemic exposed and exacerbated the fragilities of the local, regional and global food systems that lead to FLW each year.⁷¹ Some governments launched efforts for FLW prevention concurrently with support for consumers’ diets. For instance, the Government of Bangladesh purchased and distributed to consumers fruits and vegetables

at risk of being lost⁷² and the Government of Kenya issued guidelines for avoiding processing food waste.⁷³

Since 2011, with the publication of the first FAO global report on FLW, the topic has captured media attention, driven civil society engagement, catalysed private sector initiatives on data collection and (voluntary) agreements, enabled public sector consultations and mapping of local to national data availability, and guided policy and regulatory frameworks analysis.

In 2012, the Secretary-General of the United Nations declared the global Zero Hunger Challenge at the Rio+20 Conference on Sustainable Development held in Brazil. The Regional Initiative on Zero Hunger in Asia and the Pacific has been implemented in Bangladesh, Bhutan, Cambodia, India, Lao People’s Democratic Republic, Myanmar, Nepal, Timor-Leste and Viet Nam. It has been further extended to Fiji, Pakistan and Thailand. Among the five pillars of the Zero Hunger Challenge, the fifth pillar focuses on “zero loss or waste of food” and was recently confirmed as one of the 14 priorities at the 2020 APRC.

In 2015, the universal 2030 Agenda for Sustainable Development identified SDG target 12.3 among the targets of the 17 goals that all Member Nations of the United Nations are working towards. The two SDG target sub-indicators (12.3.1.a Food Loss Index and 12.3.1.b Food Waste Index) are the instruments through which SDG target 12.3 can be monitored and reported on at the national level. At the same time, the Global Food Loss Index will provide the overview.

In 2018, FAO and WHO, during the UN Decade of Action on Nutrition 2015–2025, issued the “Strengthening nutrition action: A resource guide for countries based on the policy recommendations of the Second International Conference on Nutrition (ICN2)”⁷⁴ with 60 recommendations for state and non-state actors. Recommendation 11 is “improve storage, preservation, transport and distribution technologies and infrastructure to reduce seasonal food insecurity, food and nutrient loss and waste.”



The socio-economic and environmental costs of FLW heavily impact countries. For instance, by lower availability of safe and nutritious food for the hungry and/or managing huge quantities of food waste, which go to municipal landfills in contexts where space and climate change are a challenge. At the sub-national level, cities have been launching knowledge exchange and coordination groups. For instance, the Milan Urban Food Policy Pact was launched in October 2015 and by November 2020 had 2010 signatory cities. The pact includes a work stream on ‘food waste prevention, reduction, and management.’⁷⁵

The 2014 Committee on World Food Security (CFS) policy brief on Food Losses and Waste in the Context of Sustainable Food Systems (CFS 41, 2014) based on the 2014 report on the same topic by the High-Level Panel of Experts on Food Security and Nutrition (HLPE)⁷⁶ and two other

documents including FLW that were issued by the CFS in the same year were of paramount importance for including FLW in the 2030 Agenda:

Principles for Responsible Investment in Agriculture and Food Systems: Principle 1 is to contribute to food security and nutrition. It includes recommendations on increasing sustainable production and productivity of safe, nutritious, diverse and culturally acceptable food, and reducing food loss and waste.

Sustainable Fisheries and Aquaculture for Food Security and Nutrition. The first recommendation for action is on the necessity to recognize the relevance of fish for food security and nutrition strategies, policies and programmes. Additionally, it calls on countries to support and promote initiatives to minimize fish discards, post-harvest losses and waste at all steps of the fish value chain.^{77, 78}

**BOX 9:
Blue Growth Initiative, Fish4ACP and FAO e-learning course:
Relevance of sex-disaggregated data for fisheries food loss and waste**

In 2018, global seafood production was estimated at about 179 million tonnes, of which 82 million tonnes came from aquaculture. A significant share was sourced from Asia (34 percent; excluding China). The rest came from the Americas (14 percent), Europe (10 percent), Africa (7 percent) and Oceania (1 percent). Total fish production nearly doubled during the last 20 years in Africa and Asia.

In African fisheries women make up 58 percent of actors in post-harvest activities such as handling, processing, storage, packaging, and marketing. In 2008, the Centre National de Formation des Techniciens des Pêches et Aquaculture (in Côte d'Ivoire) designed the FAO-Thiaroye processing technique. The technique improves working conditions, quality and safety, and reduces women's work burden by shortening processing time and allowing less exposure to heat and smoke while significantly reducing losses and extending the storage life of smoked fish products by up to five to six months.

In 2013, FAO launched the Blue Growth Initiative to address inefficiencies that characterize seafood value chains, particularly in coastal and island developing nations, often due to a lack of skills, technology and infrastructure that cause post-harvest losses and reduce market access opportunities. The initiative aims to engage relevant sectors that use oceans or inland waters on investment and policy development.

In June 2020, FAO launched the e-learning course on FLW in fish value chains for programme officers and technical specialists, extension agents and researchers. The e-learning course defines key concepts related to FLW in fish value chains. These include recognizing different types of FLW, describing causes of FLW, identifying solutions and distinguishing the basic principles of three different fish loss assessment methods.

SOURCE: The State of World Fisheries and Aquaculture (SOFIA), 2020; <https://elearning.fao.org/course/view.php?id=567>

Additionally, the 2017 HLPE *report Nutrition and food systems* underscored the linkage between nutrition and FLW with the overarching recommendation to “enhance opportunities that improve diet and nutrition outcomes along food supply chains.” It calls on states, intergovernmental organizations, the private sector and civil society organizations to “protect and enhance nutritional value along food supply chains, including by promoting practices and technologies to improve food safety and reduce food quality losses and waste, paying special attention to aflatoxins.”

In October 2018, the FAO Committee on

Agriculture (COAG) requested that FAO take the lead, in collaboration with relevant actors, to develop a Voluntary Code of Conduct (CoC) for FLW reduction. In October 2020, the CoC were presented to members of the COAG. The CoC was approved by the FAO Conference in June 2021. Follow-up actions include national and regional support for developing codes of good practice and technical guidelines that are informed by the generic framework offered by the CoC, supporting members in the application of the CoC and the subsidiary guidelines prepared from it, and monitoring the implementation of the CoC and reporting to the COAG on progress made.⁷⁹



© shutterstock/Kevin Hellon

The ability of state and non-state actors to prevent and reduce FLW also depends on the enabling policy and regulatory framework, and the trust the players place with each other. Trust is essential for cross-functional multi-actor and multidisciplinary collaborations and partnerships. Global level recommendations provide overall guidance as well as concrete examples of interventions for the way forward. FLW priorities concern:

- (i) improving data quality and availability for the Food Loss and Waste Indices;
- (ii) strengthening the evidence for actions that support human nutrition and FLW prevention and reduction;
- (iii) enabling non-state actors to innovate local to global food supply chains and patterns of consumption; and
- (iv) supporting small food producers in developing countries, as they are facing loss of income and/or food for their own household consumption due to FLW, along with the devastating impacts climate change.

Going from setting frameworks to implementing actions, it is relevant to analyse the role that national and local policies and laws may play on FLW prevention, reduction and generation. This should include a comprehensive mapping of data. It should identify measures in place, ownership of data and transparency, the nature of measures (compulsory or not), and the adequacy of resource allocations. In May 2015, in recognition of this need for support to FAO Member Nations, the

G20 agriculture ministers launched the FAO and partners Technical Platform on the Measurement and Reduction of Food Loss and Waste. The platform includes a Community of Practice on food loss reduction and a global Food Loss and Waste Database.

1.6.1. Global Food Loss and Waste Database, the Technical Platform on Measurement and Reduction of Food Loss and Waste and the Group of 20 (G20)

FAO has been engaged in supporting state and non-state stakeholders in policy development through improving data and sharing knowledge from all regions of the world. Specifically, in 2019, FAO launched the global and interactive Food Loss and Waste Database. The database gathers statistics and information from almost 500 publications, reports and studies from various sources such as academia, international organizations and field projects. This periodically updated data set allows users to access micro and macro analysis of food loss and waste information by year, country, commodity, stage of the value chain and activity. “The 2019 State of Food and Agriculture on Food Loss and Waste incorporates modelled loss estimates that stem from the first dataset batch from the database. The food loss estimation model was developed by the FAO Statistics Division in 2016–2018 and serves as a basis for the SDG process in the absence of actual data.”⁸⁰

In 2015, FAO and partners launched the Technical Platform on the Measurement and Reduction of Food Loss and Waste, as recommended in that year by the G20 agriculture ministers. The Technical Platform issues a newsletter, has a *Community of Practice on food loss reduction* that hosts information on the topic and a forum for discussing on various aspects of FLW prevention and reduction. It also houses the global Food Loss and Waste Database.

The Technical Platform has the overarching objective to be “relevant to both G20 members and low-income and developing countries, for sharing information and experiences in measuring and reducing food loss and waste.” It also supports global, national and local policy coherence, and gives priority “to prevention and recovery and redistribution^{xiv} of safe and nutritious otherwise wasted food to feed people.”^{xv}

The G20’s Agriculture and Water Ministers meeting in September 2020 highlighted the call from countries for improved awareness.⁸¹ The November 2020 communiqué at the end of the G20 Riyadh Summit states:

34. Agriculture: We reaffirm our commitment to tackling the challenges in food security and nutrition, as well as reinforcing the efficiency, resilience, and sustainability of food and agriculture supply-chains, especially in light of the effects of the pandemic. A significant increase in responsible investment in agriculture and food systems is needed to meet the challenge of feeding the global population and

we endorse the G20 Riyadh Statement to Enhance Implementation of Responsible Investment in Agriculture and Food Systems.

We acknowledge the goal of voluntarily establishing intermediate country-specific targets to strengthen efforts towards halving global per capita food loss and waste by 2030.

In 2015, the G20 Meetings of Agricultural Chief Scientists launched the collaborative Initiative on Food Losses & Food Waste.^{xvi} The Initiative supports the FLW Technical Platform objective through the perspective of research. The aim of the Initiative is to drive prevention and reduction at a global scale. For instance, from 2017 to 2020, the Initiative held four workshops, in Germany, Argentina, Japan and Saudi Arabia.⁸²

Delgado *et al*.⁸³ states that the G20 could mainstream SDG target 12.3 monitoring and reporting methodology for its members, promote context-specific cost-benefit analyses on FLW reduction interventions, and promote coordination “between multilateral development banks, regional banks and international organizations through the Technical Platform on Measurement and Reduction of Food Loss and Waste launched by IFPRI and FAO,” in 2015.

The Technical Platform benefited from the 2011 to 2020 experience of the FAO Global Initiative on Food Loss and Waste (SAVE FOOD) that is currently providing support to Member Nations in Europe and Central Asia.

^{xiv} In 2015, FAO provided a voluntary framework definition for recovery and redistribution of safe and nutritious food for direct human consumption: “Recovery of safe and nutritious food for human consumption is to receive, 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. Redistribution of safe and nutritious food for human consumption is to store or process and then distribute the received food pursuant to appropriate safety, quality and regulatory frameworks directly or through intermediaries, and with or without payment, to those having access to it for food intake.”

^{xv} The Technical Platform contributes to the G20 Implementation Plan for the Food Security and Nutrition Framework G20 Action plan on food security and sustainable food systems. Available at: <http://www.g20.utoronto.ca/2015/G20-Action-Plan-on-Food-Security-and-Sustainable-Food-Systems.pdf> (Consulted on 17 November 2020); Food Security and Nutrition Framework; Priority Objective 3: Increase productivity sustainably to expand the food supply: “Achieving a sustainable food system that can meet future demands will require substantial levels of research, development, innovation and technology transfer as mutually agreed to increase production sustainably, make more efficient use of inputs and reduce food waste and loss.

^{xvi} MACS-G20 members: Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, the Republic of Korea, Mexico, Russia, Saudi Arabia, South Africa, Türkiye, United Kingdom of Great Britain and Ireland, United States of America, European Union; MACS-G20 guests: Spain, CABI, CIHEAM, FAO, GFAR, GODAN, ICARDA, IFPRI, OECD, Wheat Initiative.

1.7. Regional experiences and lessons learned that guide the approach to the FAO Regional Strategy on Food Loss and Waste Reduction in Asia and the Pacific

Regions of the world are engaged in political consultations, policy formulation and strategic state and non-state collaborations, along with significant resource allocations targeting FLW prevention and reduction. To inform the development of a tailored Asia-Pacific regional strategy, an analysis of recent and ongoing strategies on FLW from other regions (Latin America and the Caribbean, Africa, Near East and North Africa, and Europe and Central Asia) were reviewed.

1.7.1. Latin America and the Caribbean

The FAO Latin America and the Caribbean (LAC) region^{xvii} estimates that annually 12 percent of food is lost from harvest to distribution with an economic loss of approximately USD 150 billion globally. These losses generate GHG emissions equivalent to 16 percent of the global carbon footprint (FAO, 2019).⁸⁴ The LAC region had an increase in overweight and obesity, while the level of undernourishment rose to 42.5 million people in 2018 from 38 million people in 2014. Food insecurity affects 187 million people.⁸⁵

The 2020 Regional Conference for Latin America and the Caribbean stated in its document on “Transforming food systems for healthy diets for all” (LARC/20/2)⁸⁶ that FAO offers technical assistance to Member Nations in the region on the circular economy approach to strengthen food production, processing, storage, distribution, and marketing measures to reduce food losses and waste.

The 2020, the FAO LAC Conference document on “Sustainable and climate resilient agriculture”

(LARC/20/4) made reducing GHG emissions a priority for the agricultural sector. It called for “reducing food losses using digital monitoring of the entire chain (for example, product storage conditions), implementing reverse logistics, reducing transport costs and identifying the dietary habits of the population.” This document is a companion to the “Hand-in-Hand towards prosperous and inclusive rural societies” (LARC/20/3) that focuses on strengthening the state and non-state partnerships for zero hunger, and “Innovation and Digital Agriculture” (LARC/20/9) that highlights innovations to transform rural areas in Latin America and the Caribbean and reduce of food loss and waste throughout supply chains. Finally, for the proposed 2021 International Year of Fruits and Vegetables, LAC countries are encouraged to establish an action network on investing in fruits and vegetables storage facilities and packaging that can also minimize losses and waste.

The Community of Latin American and Caribbean States (CELAC), under the CELAC Plan for Food and Nutrition Security and the Eradication of Hunger 2025,⁸⁷ identified FLW as a priority. CELAC’s Plan contains ten main lines of action to develop national, subregional and regional policies, programmes, strategies and projects. It has four main pillars seeking to strengthen all aspects of food security, one of which, Pillar 1: Coordinated strategies for food security through national and regional public policies, directly addresses FLW.

Countries shall strengthen their legal and institutional food security frameworks, facilitate trade, avoid losses and food waste and encourage procurement programmes. The following are the lines of action concerning FLW:

^{xvii} Antigua and Barbuda, Argentina, Bahamas, Barbados, Belize, Bolivia (Plurinational State of), Brazil, Chile, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Saint Lucia, Saint Kitts and Nevis, Saint Vincent and the Grenadines, Suriname, Trinidad and Tobago, Uruguay, Venezuela (Bolivarian State of).

- Generate information and communication campaigns to raise the awareness of each of the actors in the food chain and consumers regarding best practices to avoid food losses and waste, improving the clarity of labelling in terms of expiration date and storage; the proper application of best agricultural and veterinary practices during the primary phase of production and best manufacturing and hygienic practices in food processing, as well as any other practice or action to help prevent or reverse FLW.
- Development and training in processes and strategies for the conservation of harvest products, particularly small-scale agriculture for personal consumption or for sale; taking into account the different forms of usage and non-traditional consumption of products.
- Promote policies and programmes that strengthen the safety and quality of food produced by family farmers.
- Promote reduction of FLW, which generally involves the improvement of infrastructure, particularly transport, energy and market facilities; generating actions to raise awareness in these sectors.
- Promote the development of and facilitate access to equipment, new technology and innovation that contribute to reducing food losses at all stages of the food chain.
- Include the issue of food security and nutrition and how to avoid food losses in all education levels, especially for those directly involved with food.
- Encourage South-South Cooperation in the aforementioned items.

In implementing CELAC's plan, countries have worked on policy and regulatory development. In 2014, Costa Rica passed Law 9274/2014 that reformed its Law of the Banking System for Development and gave priority to FLW reduction initiatives. Peru issued Supreme Decree No. 055-2017-EF – Regulation of Law No. 30 498, addressing the regulatory norms that establish the promotion of food donation and facilitates the transportation of donations during natural disasters. This regulation requires the receiving entity to keep a register of donated foods that must contain the following information: 1) date the food was received; 2) description of the food received, including the unit of measure, the number of units, the name of the food and brand, if applicable, weight or volume, state of conservation, its value and the expiration date that appears in the label inscribed or attached to the container or packaging, if applicable; and 3) a list of beneficiaries or charities and social assistance institutions that received donated food.

Argentina passed Resolution 9-E/2017 that creates the national network for the reduction of food loss and waste. The network integrates all public sector agencies, private sector entities and civil society that adhere to the National Program of Food Loss and Waste Reduction. The network's objectives include: a) assist in the coordination of actions among the actors involved in the agri-food chain, in order to achieve more efficient agrifood systems; b) disseminate information about policies, programmes and projects of food waste and loss reduction from the local, provincial, national, regional and international spheres; c) generate spaces for dialogue and exchange of proposals; d) prepare an annual work plan with priority actions; and e) assist in the analysis and evaluation of projects.



1.7.2. Africa

The African Union launched the *Malabo Declaration on Accelerated Agricultural Growth and Transformation for Shared Prosperity and Improved Livelihoods* in 2014 and the Post-Harvest Loss Management Strategy in 2018. The Malabo Declaration set the ambitious Commitment 3:b – to halve the current levels of post-harvest losses by the year 2025. There is a very high variability in currently available FLW data. For instance, in sub-Saharan Africa, fruit and vegetable on-farm losses range from 0 to 50 percent, and cereal and pulse on-farm losses are highest in sub-Saharan Africa and East and Southeast Asia.⁸⁸

The 2011 *Missing food: the case of postharvest grain losses in sub-Saharan Africa*⁸⁹ reported that each year in sub-Saharan Africa, grains alone

are lost after harvest for an estimated value of USD 4 billion. The 2018 African Union Regional Post-Harvest Loss Management Strategy is structured around four pillars:

1. Policy awareness and institutional capacity;
2. Knowledge management, data, skills and human development;
3. Technology, markets and infrastructure; and
4. Finance and investment.

Each pillar has sub-objectives with proposed indicative intervention areas that include improved sharing of labour-saving and gender-sensitive technology for agribusiness and agroprocessing as well as improving markets and market infrastructure.

BOX 10:

FAO, the African Union and the Rockefeller Foundation: Project on Support to the African Union in the development of policies and strategies for national plans to reduce post-harvest losses (2016–2018)

The FAO, African Union and Rockefeller Foundation Project on Support to the African Union in the development of policies and strategies for country-specific plans to reduce post-harvest losses was implemented from 2016 to 2018. The direct beneficiaries of the project were the African Union Commission and four countries (Kenya, the United Republic of Tanzania, Zambia and Zimbabwe).

African Union Commission activities: mapping food loss activities; developing national investment guidelines, using a monitoring and evaluation framework to track progress toward achieving the 2025 post-harvest loss goal, and a continental strategy. The African Union Commission also provides technical support to the African Union and its Member Nations.

Country-level activities: forming national post-harvest technical working groups; conducting loss assessment studies; developing national post-harvest strategies and indicators; training stakeholders on food loss assessment; incorporating food loss assessment into tertiary training; developing policy briefs, and convening national workshops to validate project results and findings.

Among the project conclusions: (i) awareness creation on assessment methodologies and tools is essential because only 5 Member Nations (Malawi, Mauritania, Rwanda, Togo and Uganda) out of 49 (9 percent) managed to report food loss during the African Union January 2018 biennium review; (ii) Private sector engagement was noted to be low on the continent, and a strong business case should be developed to turn the current challenges in post-harvest management into business opportunities.

SOURCE: http://www.fao.org/fileadmin/user_upload/food-loss-reduction/AU-FAO_Regional_workshop_report.pdf

1.7.3. Near East and North Africa

FLW in the Near East and North Africa Region (NENA) are estimated to be around 250 kg per person annually. This translates into an estimated 42 km³ of water and 360 million hectares of land used to grow and distribute food that becomes FLW along food supply chains and in households. Roughly 68 percent of losses in NENA occur during the production, handling, processing and distribution stages of the food supply chain, mainly due to poor harvesting techniques, lack of cold storage and proper transport, poor handling practices, exposure to heat and sunlight, inefficient marketing systems, and weaknesses in policy and regulatory frameworks. NENA food waste at the consumption stage is estimated to be 34 percent.

In 2013, FAO Member Nations endorsed the “Regional strategic framework for food loss and waste reduction in the Near East North Africa” prepared by FAO. It outlined the FLW work in the region from 2014 to 2024 through four areas:

1. Data gathering, analytical research and knowledge generation
 - i. Identifying data and information gaps
 - ii. Collaborating with national and international research and development institutions
2. Awareness raising and promotion of good practices at all levels of the supply chain
 - i. Developing public awareness campaigns
 - ii. Developing and promoting relevant and practical procedures and technologies
 - iii. Investing in capacity building
3. Developing policies/regulations, and strengthening collaboration and networking
 - i. Developing an enabling policy environment for food loss and waste reduction
 - ii. Ensuring collaboration and coordination between all agents of the food supply chain and other stakeholders, including relevant government institutions
 - iii. Establishing regional and international networking



- iv. Create a coordination mechanism for the management of food loss and waste reduction

4. Promoting investment and specific projects

- i. Attracting investment to improve commodity supply chains
- ii. Investing in appropriate farming technologies and household equipment
- iii. Investments in use and reuse of food loss and waste
- iv. Financing actions likely to have immediate impact

Countries on the African continent and the Near East are moving ahead with strategies, critical loss point analyses and investments.

El Bilali and Ben Hassen⁹⁰ state that the countries of the Gulf Cooperation Council – Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and United Arab Emirates – should address data scarcity, consider how to strengthen prevention and redistribution. These seem to be overlooked. Baig *et al.*⁹¹ suggests that Saudi Arabia should consider awareness-raising campaigns that focus on food waste. In Oman, the National Nutrition Strategy Strategic Study (2014–2050) by the Department of Nutrition, Ministry of Health states that food waste is a problem affecting each country in the Gulf Cooperation Council. In Oman, the average family wastes about a third of all food prepared within the household.

BOX 11: The United Republic of Tanzania: National Post-Harvest Management Strategy 2019 to 2029

In the United Republic of Tanzania, weaknesses in post-harvest systems cause yearly food losses. For cereals and perishable crops, these have been estimated at between 30 to 40 percent and higher. These losses heavily impact food availability and accessibility. The National Post-Harvest Management Strategy 2019–2029 focuses on cereals, legumes, fruits and vegetables, roots and tubers, and edible oil crops. It does not include cash crops, livestock and livestock products. It covers post-harvest losses and actors along the value chain from harvesting to consumption, and is aligned with the 2013 National Agriculture Policy, the Malabo Declaration, and SDG target 12.3.

Consultations with stakeholders identified FLW causes, solutions and interventions to prioritize. Causes include gaps in mechanization of harvesting/processing and management decisions, transportation, storage, grading, consumers' attitudes, and availability of financial markets. Climate change was recognized as an amplifier of critical loss points such as harvesting and drying.

The work on the Strategy led to the Tanzania Post-Harvest Management Platform with a Steering Committee comprised of members from the Prime Minister's Office, the Ministry of Agriculture Livestock and Fisheries, Cereals and Other Produce Board, the Sokoine University of Agriculture, the University of Dar es Salaam, Tanzania Graduate Farmers Association, and members of the private sector such as INNODEV, RUDI, Frabho Enterprises, Bajuta Int (T) Ltd and SNV.

State and non-state actors co-own the nine strategic objectives:

- Facilitate awareness on post-harvest management to improve efficiency and reduce crop losses along the value chain
- Promote availability, accessibility, affordability and adoption of tested technologies and processes to reduce post-harvest losses
- Facilitate agricultural marketing systems to improve market access and minimize post-harvest losses
- Promote research and innovations of new and appropriate technologies and methods to reduce crop losses
- Review and put in place new legislations to ensure compliance with standards and adoption of practices to minimize post-harvest loss
- Strengthen institutional capacity, coordination, partnerships and stakeholders' participation of post-harvest management actors to enhance implementation of strategic interventions
- Adapt post-harvest management systems to mitigate the effects of climate change
- Address inadequacy in post-harvest loss financing
- Develop a standard methodology for collecting data and estimating post-harvest loss.

SOURCE: https://www.kilimo.go.tz/uploads/dasip/ENGLISH_STRATEGY.pdf

In the Gulf Cooperation Council, food can be wasted because of quality standards where 'imperfect' foods are discarded, 'sell-by' dates, and

consumers' attitudes. Solutions are available and some examples of implementation demonstrate the potential for scaling-up.

BOX 12: FoodWise in Mauritius, Madagascar, Côte d'Ivoire and Morocco: Food waste prevention through business innovation and support to food insecure children and adults

FoodWise was launched in Mauritius in 2018 and expanded its network to include Madagascar, Côte d'Ivoire and Morocco. To date, the organization saved 320 490 kilograms of food from being wasted by 145 partners, such as hotels, supermarkets, restaurant, wholesales, caterers or event agencies. The available safe food was recovered and redistributed to 128 charities and schools that assist children and adults in need.

FoodWise acts as an intermediary between private sector givers and the recipient associations by taking charge of the legal, logistical and administrative aspects related to the donation of food. Sustainable Food Solutions (www.sfs-global.org) collaborates for its model development.

SOURCE: <https://foodwise.mg/qui-sommes-nous/>

The 2020 FAO Regional Conference for Africa underscored that nations could share knowledge to increase fruit and vegetable production and consumption concurrently with reducing food loss and waste during the 2021 International Year of Fruits and Vegetables.⁹²

1.7.4. Europe and Central Asia

Europe has countries with heterogeneous geographies, socio-economic and demographic structures, while the climate ranges from subtropical to polar. *The State of Food and Agriculture 2019*,⁹³ indicated that the median waste percentage for fruits and vegetables at the retail level is lowest in North America and Europe at 3.75 percent, and losses exceed 10 percent. And yet, Europe faces malnutrition with impacts on health, learning abilities and productivity.

The 2020 FAO Regional Conference for Europe and Central Asia reported on the Regional Initiative on improving agrifood trade and market integration. Work on SDG target 12.3 falls under this initiative. The conference highlighted that the SAVE FOOD Initiative on FLW reduction provided technical assistance. This assistance included the development of legislation and food donation



programmes in Georgia and Ukraine, research on critical loss points in North Macedonia and Ukraine, awareness-raising for consumers in Türkiye, and educational programmes for children in Albania's schools. A regional Community of Practice on FLW reduction was established to improve the sharing of information and resources, and to facilitate collaboration and partnerships.

In the European Union, FLW prevention, reduction, and management has been influenced^{xviii} by three cornerstones: SDG target 12.3; the European Union bioeconomy objectives,⁹⁴ and the European Union circular economy priorities^{95, xix} through the work of the European Commission, the European Union Committee of Regions,^{xx} the European Parliament,^{96, 97, 98, 99, 100, 101, 102, 103} and the European Economic and Social Committee.^{xxi}

EU Directive 2018/8519 is aligned with SDG target 12.3 and sets an indicative European Union-wide food waste reduction target. It requires European Union member countries to take specific measures, create incentives for the donation of unsold food that is still edible, raise consumer awareness on 'use by' and 'best before' dates, and measure and report on progress in reducing food waste. The "Commission Delegated Decision (EU) 2019/159712 and Commission Implementing Decision (EU) 2019/200013 provide details on how to comply with the obligation to report food waste imposed by the above-mentioned Directive."¹⁰⁴

The European Commission elaborated an European Union methodology to measure and monitor food waste from production to consumption, and report for SDG target 12.3 through the multi-stakeholder EU Platform on Food Losses and Food Waste,^{xxii} which was launched in 2016, and has state and non-state members. The latest European Union data points to an annual 88 million tonnes of food waste worth 143 billion euros. Households account for more than 50 percent of the waste, processing 19 percent, food services 12 percent,

primary production 11 percent, and, wholesale and retail 5 percent.¹⁰⁵ Civil society contributed to raising awareness through campaigns led by organizations such as Denmark's Stop Food Waste and FeedBack, and, among other activities, it implemented recovery and redistribution.¹⁰⁶ The actors in the food supply chains lead FLW reduction efforts with demonstrated significant returns on investments. Some of the major corporations involved in these efforts include Tesco,¹⁰⁷ COOP, Delhaize and Sodexo.

In 2020, the Council of the European Union published the report on Food losses and food waste: assessment of progress made in implementing the Council conclusions adopted on 28 June 2016 – Information from the Presidency and the Commission. It states that all member countries "have adopted varied legislative and non-legislative national measures to reduce food loss and waste." Several countries in this region have included the topic in their national plans, either specifically on food waste or in areas compatible with it. They have identified market-based instruments for prevention, reduction and management, such as reducing VAT rates for donated food, revising legislation promoting food donations, and providing support to food banks and non-profit organizations that distribute donated food. Countries have started to implement voluntary agreements between the private sector and civil society. They are engaging in data collection because of the high degree of differentiation between countries in availability and quality of data. Lastly, they have launched awareness raising initiatives.¹⁰⁸

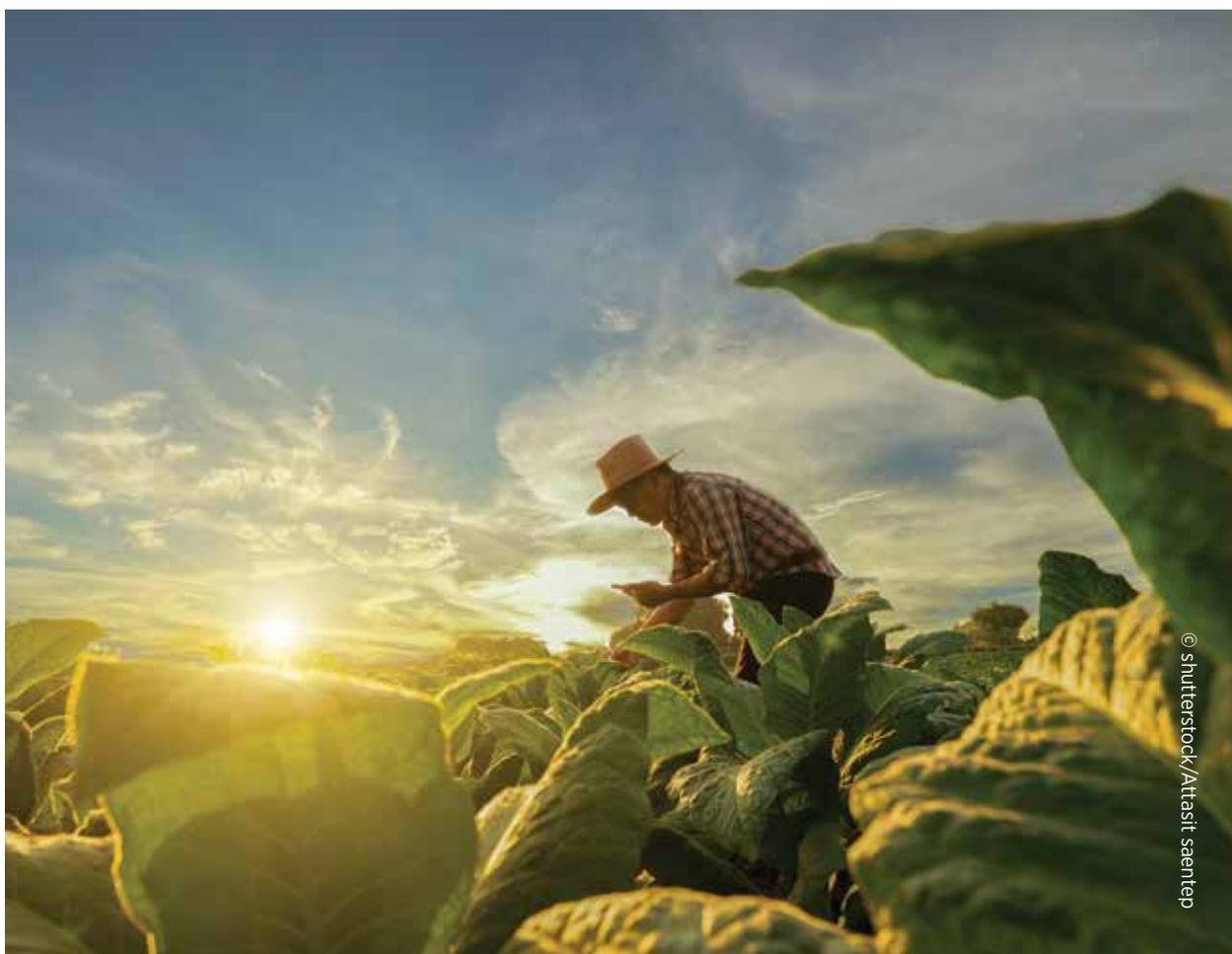
^{xviii} Including the Common Agricultural Policy and the Common Fisheries Policy.

^{xix} The European Court of Auditors (2016) published the report on 'Combating Food Waste: An Opportunity for the EU to Improve the Resource Efficiency of the Food Supply Chain,' arguing that more concrete actions are needed because results were still weak.

^{xx} The European Committee of the Regions. 2017. Opinion 'Towards a Sustainable EU Food Policy That Creates Jobs and Growth in Europe's Regions and Cities' that selected seven best practices from across the EU, from food donation to awareness-raising campaigns to separate waste collection.

^{xxi} EESC issued in 2013 an Opinion on Prevention and reduction of food waste and, in 2014, published the report on Food donation: fighting food poverty and addressing food waste.

^{xxii} EU Platform on Food Losses and Food Waste, in addition to plenary meetings, operates in sub-groups to examine specific aspects and/or questions related to food waste. Four sub-groups have been established to date: food donations, food waste measurement, action (and roadmap) on implementation, and date marking and food waste.
https://ec.europa.eu/food/safety/food_waste/eu_actions/eu-platform_en



Countries in the Europe have started to implement FLW strategies. Czechia and Italy are two examples. In early 2018, Czechia passed an amendment to its Food Act that now requires all food retailers with a store surface above 400m² to facilitate food waste reduction by establishing contracts with relevant charitable organizations to donate unsold food to charities. Italy passed Law No. 166 on the donation and distribution of food and pharmaceutical products for purposes of social solidarity and food waste prevention. It lays down provisions reorganizing the regulatory framework on food donation by simplifying and harmonizing the process.

It established that food recovery and redistribution of food for the most deprived as a priority in FLW prevention and reduction. The law addresses the difference between the “use by” and “best before” dates and clarifies that food products may be donated even if their “best before” date has passed. It also provides other useful tools such

as the opportunity to donate confiscated food products, the “family bag” for food services, and the application by local authorities of a reduction coefficient on waste tax in order to further encourage businesses to donate surplus food.

The United Nations Economic Commission for Europe (UNECE) has produced a code of good practice for handling fresh produce to minimize loss.¹⁰⁹

In November 2020, with facilitation from FAO, the joint Food Loss and Waste Strategy Committee for Central Asia, Azerbaijan, and Türkiye was established.¹¹⁰ The Committee, an inter-governmental body, will guide the work in targeted countries (Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Türkiye, Turkmenistan and Uzbekistan) on the formulation of national FLW strategies. The strategies will be based on creating a hierarchy of critical loss points, conducting cost- benefit analyses for identified solutions along food supply chains, and policy and legislation analyses.

BOX 13: Türkiye: National Strategy and Action Plan on the Prevention and Reduction of Food Loss and Waste

In 2013, Türkiye launched a campaign targeting prevention of bread waste that was estimated, at the time, at 2.1 billion loaves/year, or six million loaves/day, with an economic value of nearly USD 0.8 billion. The campaign was effective in terms of increasing social awareness and ensuring effective use of resources. It was estimated that 384 million loaves of bread have been saved from becoming waste with an economic savings of USD 1.4 billion. To reduce bread waste, different actions were implemented, such as training actors in the bread supply chain, preparing and broadcasting messages on several media channels, and distributing recipes for dishes that use stale bread.

In December 2019, FAO started the implementation of a technical assistance project on the reduction of Food Loss and Waste in Central Asia, within the framework of the second phase of FAO-Türkiye Partnership Programme on Food and Agriculture. The programme aims to assist the recipient countries – Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Türkiye, Turkmenistan, and Uzbekistan – in developing national strategies and action plans for reducing food loss and waste. It is also implementing key strategic actions for technical support to a wide range of stakeholders from farmers to consumers. Various consumer-facing communication activities, such as media campaigns, are being designed to create awareness and improve understanding of the causes and impacts of FLW, and to drive behaviour change.

In May 2020, FAO and the Ministry of Agriculture and Forestry of Türkiye launched a joint national media campaign called “Save Your Food” to raise public awareness about the detrimental impacts of food loss and waste, and to stimulate action along supply chains. The campaign also released the National Strategy and Action Plan on the Prevention and Reduction of Food Loss and Waste in Türkiye. The strategy was developed by FAO and the Ministry of Agriculture and Forestry, taking into consideration reviews and recommendations of over 100 stakeholders from the private sector, non-governmental organizations and academia.

The strategy’s action plan contains 95 concrete measures, including legal, policy, technical, educational and communication measures. For its implementation, a series of meetings were organized with the Union of the Municipalities of Türkiye. Support and guidance from the Union is crucial to deliver on the plan’s targets. The Municipalities of Ankara and Istanbul committed to support the national strategy through implementation of relevant actions from the plan, and dissemination of messages and tools for prevention and reduction actions.

SOURCE: FAO-Turkey Partnership Programme on Food and Agriculture (FTPP II). Reduction of food loss and waste in Central Asia, Azerbaijan and Turkey. GCP/SEC/015/TUR <http://www.fao.org/3/cb1132en/CB1132EN.pdf>

1.7.5. Analysis of regional experiences and lessons learned

Regions target and tailor their FLW prevention and reduction measures to their contexts. They have developed regional strategies to address FLW using improved data. All regions tackle both food losses and food waste, confirming the

literature findings that FLW is a global challenge that impacts developed and developing nations. However, there are cases where food losses, due to their high impact on food security through reduced availability, have priority. Evidence for this is found in the *Malabo Declaration on Accelerated Agricultural Growth and Transformation for Shared Prosperity and Improved Livelihood*. All reviewed regions tackle FLW through state and non-state platforms and multidisciplinary working groups.

Regions have identified that:

- Data on food losses and food waste are not of sufficient quality and quantity. Therefore, regions have mapped methods and allocated resources for food supply chain level analyses, national statistical reviews and other information-gathering efforts.
- Regions have launched platforms for state and non-state dialogues. These are used to consult on available information on the quantities of FLW and solutions, strengthen understanding on the socio-economic and environmental impacts of FLW, and coordinate messages to consumers, among others. Children, identified as change agents for communities and schools, were included in the stakeholders' lists.
- All regions, though not at the same level, recognized that small food producers face challenges. These include applying adequate agricultural and veterinary practices, accessing finances and markets, and ensuring negotiating power in contractual agreements.
- Training on FLW measurement, reporting and monitoring is taking place. Scaling up this training, along with policy and legislative review and development, is necessary.
- Food contact materials such as packaging, and infrastructure, particularly transport, energy and market facilities, are linked with challenges in FLW reduction in all regions.
- Socio-technological innovations, such as artificial intelligence, have been initiated to provide solutions for producers, retail and food services in addressing FLW measurement and reduction. Solutions could target private sector operations or link them with consumers.

National level actors and regional bodies are engaged in FLW prevention and reduction along with local authorities.

Local authorities, such as municipalities, started to create knowledge products on good practices, engage in peer-to-peer capacity development, and generate data in support of the Food Loss and Food Waste Indices. From October to November 2020, the Milan Urban Food Policy Pact signatory cities^{xxiii} hosted regional webinars focused on practical examples of how cities respond to COVID-19 in Europe, Asia-Pacific, Latin America and the Mediterranean. For Asia-Pacific, the city of Seoul, in the framework of the Seoul Urban Food Policy Conference, organized the second Milan Urban Food Policy Pact Regional Webinar entitled “Sustainable Food in the era of COVID-19 pandemic”.¹¹¹

In Asia and the Pacific, a customized strategy is also needed considering the co-existence of food loss and waste in many mixed-level economies. For example, FAO, in partnership with regional organizations such as the Association of Southeast Asian Nations (ASEAN) or the Asia-Pacific Economic Cooperation (APEC), may provide the basis for developing platforms for engaging countries to effect change through multi-sectoral approaches. There is already strong interest in FLW issues in Asia and the Pacific at the regional and national levels, with some countries, such as Thailand and Australia, designating funding for the achievement of SDG target 12.3.

An enabled private sector can reduce FLW directly. At the same time, international organizations, financial institutions and civil society have already started to have conversations on awareness-raising opportunities and the visibility of technological monitoring tools. These are taking place in parallel with food supply chain interventions that address critical loss and waste points, while also contributing to the Food Loss and Food Waste Indices. What follows is a selection of examples of engagement by international organizations and financial institution that inform the formulation of the *FAO Regional Strategy on Food Loss and Waste Reduction in Asia and the Pacific*.

^{xxiii} In 2019 FAO, Milan Urban Food Policy Pact Secretariat, and RUAF published The Milan Urban Food Policy Pact Monitoring Framework that includes four indicators on FLW: 41. Total annual volume of food losses and waste; 42. Annual number of events and campaigns aimed at decreasing food loss and waste; 43. Presence of policies or regulations that address food waste prevention, recovery and redistribution; 44. Total annual volume of surplus food recovered and redistributed for direct human consumption.

1.8. Overview of engagement in FLW prevention and reduction by international financial institutions, the private sector and civil society

1.8.1. International financial institutions

The turning point of awareness on FLW was the publication of the FAO 2011 report that launched the FLW topic at the global level. Until the 2014 Committee on World Food Security (CFS) policy recommendations on FLW, the majority of financial support for interventions and field projects focused on post-harvest loss reduction in selected supply chains in developing countries. These mainly involved the use of new technologies in selected food supply chains.¹¹² However, since 2015, the comprehensive sustainable food system approach to FLW reduction, in both developing and developed economies, started to gain interest from practitioners. FLW data quality and translated impacts had increased visibility and debate space in the research and policy arena.¹¹³ International financial institutions (IFIs) have been supporting efforts on FLW prevention and reduction for decades.^{114, 115}

In 2019, the World Bank launched the first Sustainable Development Bond^{116, xxiv} to raise awareness for the importance of minimizing FLW with an investment of USD 300 million by the Folksam Group.¹¹⁷

“Current food and other resource consumption levels are not sustainable. We need to urgently focus on how to feed a growing population without further harming the planet. Through our partnership with Folksam on this bond, we hope to draw attention of investors to this global challenge, as well as highlight the role they can play in supporting solutions through their own operations.”

– Jingdong Hua, World Bank Vice President and Treasurer (Washington, D.C., 20 March 2019)

“Halving global food waste per capita and reducing food loss along the entire supply chain by 2030 are essential to manage scarce resources and improve nutrition, as well as tackle climate change.”

– Laura Tuck, World Bank Vice President for Sustainable Development (Washington, D.C., 20 March 2019)

The World Bank also engages through joint work with FAO¹¹⁸ and through its substantial loan and grant portfolio.¹¹⁹ It has funded work on food loss measurement in selected food supply chains in Guatemala, Nigeria, Rwanda and Viet Nam.¹²⁰ Support has also been provided to middle-income countries to address FLW from farm to fork through investments in infrastructure, access to markets, logistics and waste management. For instance, “IBRD [International Bank for Reconstruction and Development] finances grain storage in Mexico¹²¹ to reduce post-harvest losses in maize, wheat and beans, while increasing the competitiveness and market inclusion of small and medium-sized grain producers.”¹²²

The Asian Development Bank (ADB) Operational Plan for Agriculture and Natural Resources: Promoting Sustainable Food Security in Asia and the Pacific in 2015–2020 provides guidance for increasing emphasis on food security and agriculture productivity. The plan, which builds on the earlier Operational Plan for Sustainable Food Security in Asia and the Pacific (2010–2014), focuses on agriculture and natural resources sector operations in four priority areas:

^{xxiv} According to the World Resources Institute (WRI), the World Bank’s Sustainable Development Bonds has raised over USD 1 billion in investments since the first transaction in March 2019 has raised over USD 1 billion in investments.

- increasing the productivity and reducing pre- and post-harvest losses;
- improving market connectivity and value chain linkages;
- enhancing food safety, quality and nutrition; and
- enhancing management and climate resilience of natural resources.

The African Development Bank (AfDB) was the first and currently estimated largest IFI investor in post-harvest loss reduction. The plans and goals of AfDB continue those of the Programme for Post-Harvest Loss Reduction Strategy¹²³ that, from 2010 to 2015, invested a total indicative cost of USD 1 692 million in four main areas: policy formulation and institutional strengthening, rural infrastructure, technologies for post-harvest loss reduction, and value addition and market development. The programme aimed to reduce quantitative food losses, improve food availability and enhance product quality through investments in rural infrastructure that facilitate supply-chain efficiency, and strengthen post-harvest and agro-processing technologies.

The International Fund for Agriculture Development (IFAD) post-harvest portfolio is particularly significant. Between 2013 and 2016, IFAD approved the disbursement of at least USD 433 million for upgrading post-harvest infrastructure, equipment and capacities that are essential to enable poor farmers and entrepreneurs to minimize food losses. This amounts to around 12 percent of the total disbursement approved by IFAD during the same period, or approximately USD 100 million per year. This earmarked investment covered the following: USD 371 million for improved post-harvest infrastructure, including roads, collection centres, storage warehouses, and processing and packaging facilities; USD 35 million to upgrade equipment for crop harvesting, post-harvest handling, drying, cooling, storage, processing and transport; and USD 27 million for training farmers, farmer groups and value chain operators on post-harvest techniques, including operations and maintenance.

At the same time, the shift to food loss minimization can be strengthened through decision-makers that undertake a systems transformation approach, given the multi-dimensionality of interventions required to address losses. FLW monitoring and reporting for the SDG Food Loss Index can support this path, and an additional bird's-eye view could be provided by monitoring diverse food groups that can constitute a varied diet: crops, livestock and fisheries. For instance, FLW of fish, both wild and aquaculture, represents a direct link between SDG target 12.3 and SDG 14. As a country-level example, Indonesia is the world's third largest producer of fish at approximately 6 million tonnes per year. The country faces a significant lack of access to technologies that could allow small-scale fishers from coastal communities to preserve their catch until it reaches markets, resulting in up to 35 percent FLW before consumption. From 2012 to 2017, the Coastal Community Development Project,¹²⁴ supported by IFAD and co-financed by Indonesia's Ministry of Marine Affairs and Fisheries, implemented activities that reduced FLW through developing entrepreneurship capacities, improved quality, and access to technologies and markets.

Asia and the Pacific is estimated to be the largest recipient of IFAD post-harvest investment. IFAD earmarked an estimated USD 178 million to post-harvest infrastructure, equipment and capacity between 2013 and 2016 in the region, which is equal to 14 percent of total disbursement to the region approved in the same period. Asia and the Pacific also has the highest average per-project resources earmarked through loan and grant programmes approved for post-harvest infrastructure, equipment and capacity, with an average of USD 4.57 million per project approved between 2013 and 2016.

In 2019, within the European Bank for Reconstruction and Development (EBRD)'s Agribusiness Strategy (2019–2023) and the Green Economy Transition Approach (GET), and in partnership with FAO, national guidelines were produced for Türkiye and Greece to identify policies and business practices that would minimize supply FLW.¹²⁵

1.8.2. Private sector initiatives

The FAO 2019 findings show that there are significant challenges in enabling private sector investment for FLW minimization, and uncertainty about the effects that a lower level could have on different actors in supply chains. However, the private sector is the link between the production-transformation-distribution part of the chain and the consumption of food. The private sector is both a potential generator and minimizer of FLW, as FLW directly impacts their own business model sustainability, and an enabler of prevention or generation of food waste for consumers.

HLPE¹²⁶ defines food environments as “the physical, economic, political and socio-cultural context in which consumers engage with the food system to make their decisions about acquiring, preparing and consuming food.” This definition includes decisions and behaviours that prevent or generate food waste. The private sector can play a proactive role in generating data on food waste, implementing solutions for prevention and reduction, and enabling consumer behaviour change. It can do this through various methods, including information technology solutions such as applications that facilitate food donations or purchases at discounted prices.



© shutterstock/The Road Provides

BOX 14: Tesco stores going into global food waste reduction

Strategy: In 2013, Tesco (United Kingdom of Great Britain and Northern Ireland) was the first supermarket chain to publish independently audited food waste data. Annual reports have pushed the agenda forward and, in 2020, the group was working on food waste minimization through three streams: in its own operations, for its suppliers, and by supporting its customers and communities. Tesco's CEO is Chair of Champions 12.3.

Partnerships for food waste prevention: In 2020, 2 700 Tesco branches rolled out a partnership with the app Olio and its more than 8 000 local volunteers to collect surplus food nearing its expiration date and donate it to people in need. The food redistribution charity FareShare works with, among others, Tesco, Sainsbury, Asda, Co-op and Aldi. In 2017 through 2018, Tesco donated 7 975 tonnes of edible food.

Training the community cooks for better nutrition: Jamie Oliver, a famous chef, collaborates with Tesco to train more than 1 000 community cooks in meal preparation from food donations, reaching through them around 5 000 centres serving local communities across the United Kingdom of Great Britain and Northern Ireland.

Tesco Malaysia: In October 2016, Tesco Malaysia began collaborating with the Food Aid Foundation and Kechara Soup Kitchen where it donated unsold but edible fruits, vegetables and bakery products. All 59 Tesco Malaysia stores are offering food surplus to charities and community groups.

Malaysia, reflecting the country's enabling environment, launched a food waste prevention awareness raising campaign followed by pilot projects at the community level. An "Eat Smart, Save Food" programme (2019–2020) was implemented in a number of Malaysian communities that cut household food waste by 43 percent in seven months.

In 2019, Tesco was the first retailer in the country to publish its food waste data. "As a retailer we know that perfectly matching supply and demand is particularly challenging, leading to some unsold surplus food. Therefore, transparency and measurement are essential for identifying hotspots and in tackling the causes of food waste, because what gets measured gets managed," said Tesco Malaysia Chief Executive Officer Paul Ritchie.

In 2018 and 2019, a total of 414 834 tonnes of food sold by Tesco Malaysia generated 7 048 tonnes of unsold surplus, equivalent to 1.70 percent of sale, from which 610 tonnes were redistributed to charity homes, community groups, schools and families in need through food bank partners.

SOURCE: <https://resource.co/article/tesco-ranked-top-supermarket-food-waste-prevention>; <https://www.tesco.com.my/Our-Little-Helps/Projects/Tesco-Malaysia-Food-Waste-Data-2018-19/2019/ProjectDetails/>

In 2016, the Rockefeller Foundation launched YieldWise, a USD 120 million initiative on reducing loss of fruits, vegetables, and staple crops in Kenya, Nigeria, the United Republic of Tanzania and the United States of America. Actions focused on fixing broken supply chain links, helping farmers access technologies and solutions, investing in financing models and technology innovations that drive mutual economic growth, and engaging global businesses in accounting for the food lost and wasted in their supply chains beyond their

factories. Results from 2016 to 2020 showed that 400 million tonnes of surplus food were rescued and redistributed to American families, and 300 000 farmers were empowered with training and access to technologies that reduced losses by 20 to 30 percent, providing additional income and improving food security. Particularly, loss-reducing technologies were introduced across three value chains: maize, mango and tomato in the United Republic of Tanzania, Kenya and Nigeria, respectively.¹²⁷

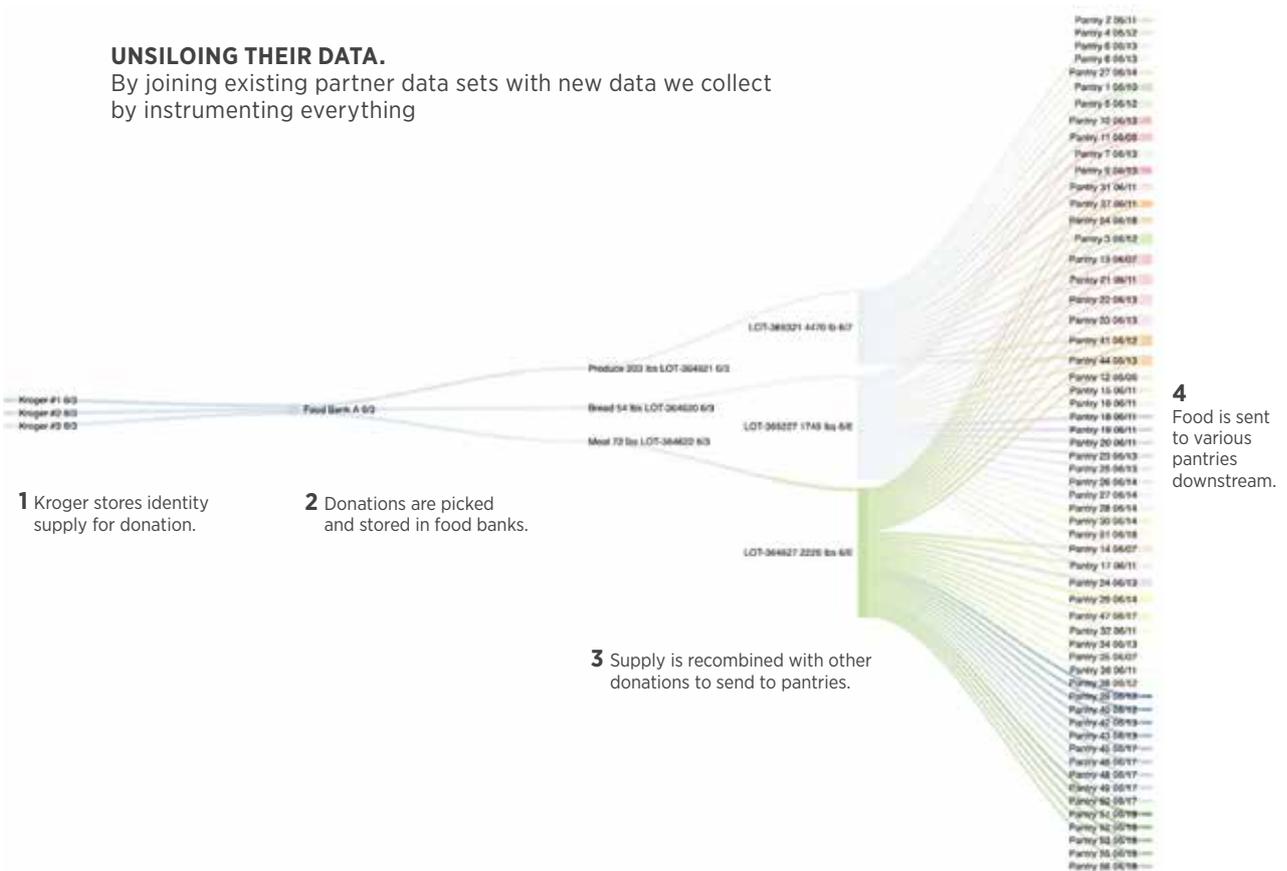
In 2020, the Rabobank and FAO signed a new partnership agreement. It will begin with a review of the dairy sectors in India and Kenya, with a view to reducing food losses and promoting a transition to more sustainable food systems.¹²⁸ The winners of Rabobank's 2020 FoodBytes! Pitch, a start-up discovery programme, included AgriCycle, a firm that works in East and West Africa and Latin America with around 35 000 farmers. Its winning pitch was for a solar-powered small-scale technology that dries tropical fruits and is accessible to smallholder farmers.¹²⁹ In 2018, the Rabobank Foundation hosted and sponsored an Asia-focused Food Loss and Waste Challenge to stimulate innovative start-ups for solutions. The FAO Regional Office for Asia and the Pacific supported the foundation in the development of selection criteria and scoring. The top five start-ups in alphabetical order (and with categories noted) were as follows:

- CropIn Technology Solutions (Precision Farming): An intuitive, intelligent, self-evolving system that delivers future-ready farming solutions to the entire agricultural sector. With capabilities of live reporting, analysis, interpretation and insight that span geographies, their solution digitizes every farm, while data managing the entire ecosystem. (www.cropin.com)
- Eachmile Technologies (Farmer Services, Fish): Uses mobile technology to provide fishers and farmers with the data they need to improve their livelihoods, and connect each link of otherwise fragmented supply chains. (www.eachmile.co)
- Ecozen Solutions Pvt. Ltd. (Solar): Provides renewable energy-based products that can store and transport perishables along the value chain. Ecozen was the winner of the challenge. (www.ecozensolutions.com)
- Elixia Tech Solutions Ltd. (Supply Chain): Provides comprehensive and customized solutions for transportation, logistics and supply chain management across industries by converting accurate and real-time data into actionable business intelligence. (<http://speed.elixiatech.com>)
- Pula Advisors (Farmer Services): Develops and distributes bundles of financial and agronomic services for smallholder farmers. The bundle includes agricultural inputs, insurance and precision agronomic advisory. (www.pula-advisors.com)

Google has been working on data un-siloing to prevent food waste and address food insecurity in the United States of America. Working with data from retail chain Kroger, Google focused on shrink data analysis, which measures loss of grocery store inventory due to imperfection, spoilage, and other factors. The analysis sought to identify and match safe and nutritious food at risk of becoming waste with the food bank Feeding America that receives and delivers the at-risk food to the food insecure population.

Some private-to-private collaborations to reduce food waste have been launched in the Asia-Pacific region. The Solar Impulse Foundation has annual awards that recognize food waste minimization innovations in the region. In 2019, the award went to Winnow Vision,¹³⁰ an artificial intelligence-enabled tool available in more than 40 countries that can track food waste from food services. It reported a reduction in food costs of 2 to 8 percent after 90 days.¹³¹ In 2020, the award was given to Bangkok-based LightBlue Environmental Consulting, which works with FIT Food Waste Monitoring Tech, an agile solution that tracks commercial kitchen food waste and associated costs at multiple locations.¹³²

FIGURE 7:
Food loss percentages in different metrics, global and regional levels, 2016 baseline



SOURCE: Google Cloud. <https://cloud.google.com/blog/products/data-analytics/reducing-food-waste-and-insecurity-with-cloud-data-analytics>

1.8.3. Civil society initiatives

There are numerous initiatives from civil society that contribute to FLW prevention and reduction. Among these, food banks work with food producers, manufacturers, distributors, retail stores, and consumers to recover food, and with community organizations for redistributing the food to people in need. Recovery and redistribution are possible with the collaboration and coordination between the private sector and the recipients, such as school feeding programmes, food pantries, soup kitchens, hospices, after-school programmes, and other non-profit programmes.

Food banks have also been engaging in developing policy and legislation worldwide. The recovery and redistribution of safe and nutritious food for human consumption is one of the key solutions to preventing food waste at its source. It relates to laws and policies concerning “Good Samaritan” or liability protection laws, tax incentives for food donation and tax policy disincentives, food date labelling laws, food safety regulations, and food waste management.¹³³

BOX 15: Brief overview on the impact of food banks and their partners

The Global FoodBanking Network (GFN)

In 2019, GFN's network of food banks reached and delivered food to more than 9 million people in 34 countries, up from 7.8 million people in 2018 and 7.1 million in 2017. This was possible through 943 food banks that worked with 55 681 social services agencies worldwide, up from 811 in 2018 and 794 in 2017. The total food and grocery products delivered in 2019 were 503 million kg, up from 472 million kg in 2018 and 427 million kg in 2017.

From 2019 to 2021, the Harvard Food Law and Policy Clinic and GFN worked together on the Global Food Donation Policy Atlas. The project focuses on national policy and legislative analysis related to food donation in 15 countries for identification of the most common legal barriers to food. At the same time, the collaboration is sharing best practices on the topic. The 15 countries are Argentina, Canada, Chile, Colombia, Costa Rica, Dominican Republic, France, Guatemala, India, Mexico, Peru, Singapore, South Africa, the United Kingdom of Great Britain and Northern Ireland, and the United States of America.

The European Food Banks Federation (FEBA)

In 2019, the non-governmental organization FEBA had 24 full members and five associate members, with 430 food banks and branches. FEBA redistributed 768 000 tonnes of foodstuffs, from which 70 percent were saved from being wasted. Operations were possible with the collaboration of 32 280 co-workers, out of which 84 percent were volunteers. From 2019 to 2020, the demand for food increased by 30 percent.

FEBA is a member of the European Union Platform on Food Losses and Food Waste and contributed to two food donation guidelines: European Union guidelines on food donation issued by the European Commission in 2017, and Every Meal Matters, which are food donation guidelines, endorsed in 2016 by the EC and the EC Standing Committee on Plants, Animals, Food and Feed (by FoodDrinkEurope, FEBA, EuroCommerce).

SOURCE: <https://www.foodbanking.org/2020annualreport/>; <https://www.eurofoodbank.org/en/annual-report>

Food banks have operations worldwide. In China, the first food bank was established in 2015 by a charity organization in Shanghai under the name "Green Food Bank".¹³⁴ The Green Food Bank organized events and programmes to find donors and match them with the community needs. Approximately 22.5 tonnes of food and grocery products were distributed by Green Food Bank in the first half of 2015.¹³⁵ Currently, the Green Food Bank is the only certified food bank in China under the Global Food Banking Network.¹³⁶

The Asia and the Pacific region has different models of recovery and redistribution of safe and nutritious food for the people in need.

In 2016, the Global Forum for Food and Agriculture (GFFA) hosted a panel organized by FAO on

Opportunities for public-private-civil society collaboration for promotion of urban food security and nutrition through redistribution of food at risk of loss or waste. The panel had Vivek Agrawal of the Indian non-governmental organization Annakshetra; Craig Nemitz of the Global FoodBanking Network based in the United States of America; Uwe Wrieden, the mayor of the German city of Wietzenhof; Sabine Werth, the founder and chairperson of the Berliner Tafel of Germany; and FAO Senior Nutrition Officer Warren T K Lee.

The panel considered methodologies to assess the impact of food losses and waste on nutrition, the potential contribution of food recovery and redistribution to food security and nutrition in cities and urban areas, and ways to ensure that food remains safe and nutritious for human

BOX 16: Brief overview on the impact of food banks and their partners

Roti Bank is a non-governmental organization initiated by the Roti Foundation Mumbai in 2017.

The Roti Bank works with caterers, wedding planners, and other food services to rescue surplus food and serve the hungry. Food hygiene levels are checked before the redistribution, done within three to four hours.

COVID-19 significantly increased the need for food among the population groups under lockdowns. In March 2020, the Roti Bank was redistributing 1 000 meals daily, and in June 2020, it reached around 37 000 meals every day. Operations also started in Nagpur, Coimbatore and Hyderabad.

SOURCE: <https://rotibankfoundation.org>

consumption.¹³⁷ The GFFA 2016 Communiqué at the 8th Berlin Agriculture Ministers' Summit, *How to feed our cities? – Agriculture and rural areas in an era of urbanization*, stated:

“We, the agriculture ministers assembled at the GFFA 2016, regard it as our duty to strive to create the political, economic and social framework for ... efficient and reliable supply and value chains: We want to ... actively support the platform for reducing food loss and waste initiated by the G20 agriculture ministers in cooperation with the FAO in 2015.”¹³⁸

G20 countries called for improving FLW awareness, novel practices and innovative approaches at the digital Agriculture and Water Ministers meeting hosted by Saudi Arabia in September 2020.

1.8.4. Public, private and civil society social and technological innovations

In 2016, a consortium of public, private and international organizations launched the Food Loss and Waste Accounting and Reporting Standard. This tool can be used for tracking FLW on production sites, retail, manufacturing, hospitality/ foodservice and households. The tool focuses on identifying the destination of

quantitative loss or waste. It does not capture the qualitative dimension of FLW¹³⁹ nor does it provide mechanisms for data aggregation and scaling up from supply chains to the local and national levels. The Consumer Goods Forum took the lead in launching the standard with the World Resources Institute, UNEP, FAO, the World Business Council for Sustainable Development (WBCSD), the European Commission (EC), and the Waste & Resources Action Programme (WRAP).

Private sector actors used the FLW Protocol and Standard to conduct case studies to see what data could be generated through it. In 2017, the World Resources Institute cited the lack of awareness of available tools to monitor waste and generate a cost-benefit analysis to drive action. A data pool was amassed of almost 1 200 business sites across 17 countries with more than 700 companies from food manufacturing, retail, hospitality and food services. For every USD 1 invested in food waste reduction, half of the surveyed company sites realized a USD 14 or greater return. Within two years, 80 percent of the sites surpassed a 1:1 cost-benefit ratio. Company sites with the highest returns tended to be restaurants. Hotels, food service companies and food retailers tended to have ratios between 5:1 and 10:1. Costs consisted of purchasing smart scales or similar measurement technologies and training staff.¹⁴⁰

From 2015 to 2017, an innovative partnership between FAO and the International Food Waste Coalition (IFWC)¹⁴¹, which represents the food services industry, co-produced a guide on prevention and reduction of food waste in schools. Titled *Do Good: Save Food!*, the guide is publicly available and adapted to four different age groups of school children from 5 to 14-plus years old. The educational guide materials are adaptable to different countries and education systems. The FAO Regional Office for Asia and the Pacific can facilitate localization and consultations with state and non-state actors on opportunities for implementation. It can be applied within formal or informal educational settings, and can be adapted to rural and urban contexts.

From 2015 through 2017, SKOOL (School Kitchen Organization Optimization Learning) tested the FAO/IFWC educational guide on food waste reduction in 18 schools and canteens in Italy, France, Belgium and the United Kingdom of Great Britain and Northern Ireland. It educated 5 000 children about the issue. Additionally, 13 pilot kitchens were guided on ways to minimize food waste and they saved 2.8 tonnes of food, reaching a 15 percent reduction in food waste by the end of the pilot.¹⁴²

Champions 12.3 is a coalition of executives from governments, businesses, international organizations, research institutions and civil society who are dedicated to inspiring and mobilizing action for progress toward achieving SDG target 12.3 through tools for private sector actions and visibility of the topic.

POSTER 1:
Do Good! Save Food! Together we can fight food waste: 9 easy tips



BOX 17: Champions 12.3: Strategies for reducing food loss and waste in restaurants

- 1. Measure.** Quantifying food waste helps to identify how much and where food is being wasted and to prioritize hotspots to tackle and monitor progress over time. For detailed analysis, digital tools are needed to measure food waste. Manual measurement systems are available and provide the user with a basic overview of where food waste occurs, typically at a very low cost. However, manual measurement systems tend to under-report waste and so may not capture all opportunities to reduce waste. In many cases, chefs report that accurate measurement of food waste using smart scales gives them better control over their kitchens and a better understanding of food order patterns.
- 2. Engage staff.** Staff engagement is the key variable that determines the success of a food waste-reduction programme. Kitchen and service staff often want to help prevent food waste but need more definition and guidance. This guidance could come in the form of daily staff meetings, casual conversations, formal training, or even peer learning opportunities.
- 3. Reduce overproduction.** Food waste measurement helps many restaurants find opportunities to safely scale back production while still meeting customer demand. This measurement can help kitchen managers and chefs refine their production sheets over time. Simply tracking production and waste consistently can help identify waste hotspots, and many restaurants find that overproduction is responsible for a large proportion of their food waste.
- 4. Rethink inventory and purchasing practices.** Restaurants that want to prevent food waste need to critically examine their current inventory management and purchasing practices. If a restaurant is measuring its waste and production schedules, engaging staff, and working to reduce overproduction, especially in waste hotspots, it should then consider making deeper adjustments to its inventory and purchasing practices to further streamline its standard operating procedures and reduce waste.
- 5. Repurpose excess food.** Because forecasting customer demand is not a perfect science, restaurant kitchens will find themselves with extra ingredients and potential wasted food. In these cases, having a Plan B for how to safely repurpose these ingredients can allow the kitchen to generate revenue from this potential waste.

SOURCE: <https://champions123.org/the-business-case-for-reducing-food-loss-and-waste-restaurants/>

1.8.5. Analysis of engagement in FLW prevention and reduction

The range and scope of the interest and types of interventions described in this section provide an insight on the diverse engagements in both food loss and food waste from state and non-state actors. From the review of regional strategies and selected country-level examples, there is a strong interest in engaging in FLW reduction through knowledge transfer, co-ordination of initiatives and investments, and improving statistical measurement in line with SDG target 12.3. At the same time, priorities determine different starting points in tackling FLW.

Research and academia can strengthen the visibility of the role they play in working towards reaching SDG target 12.3 in Asia-Pacific. In the past decade, more global literature has been produced about FLW. However, research should now re-focus on making the connection between generating better data and translating it into human nutrition, climate and economic costs that can be minimized through FLW prevention and reduction.¹⁴³ For this step to be feasible, collaboration between academia, the private sector and public authorities is critical as data flows could feed real time decisions.

The FAO Do Good: Save Food! educational toolkit for school children aged 5 to 14-plus years can be

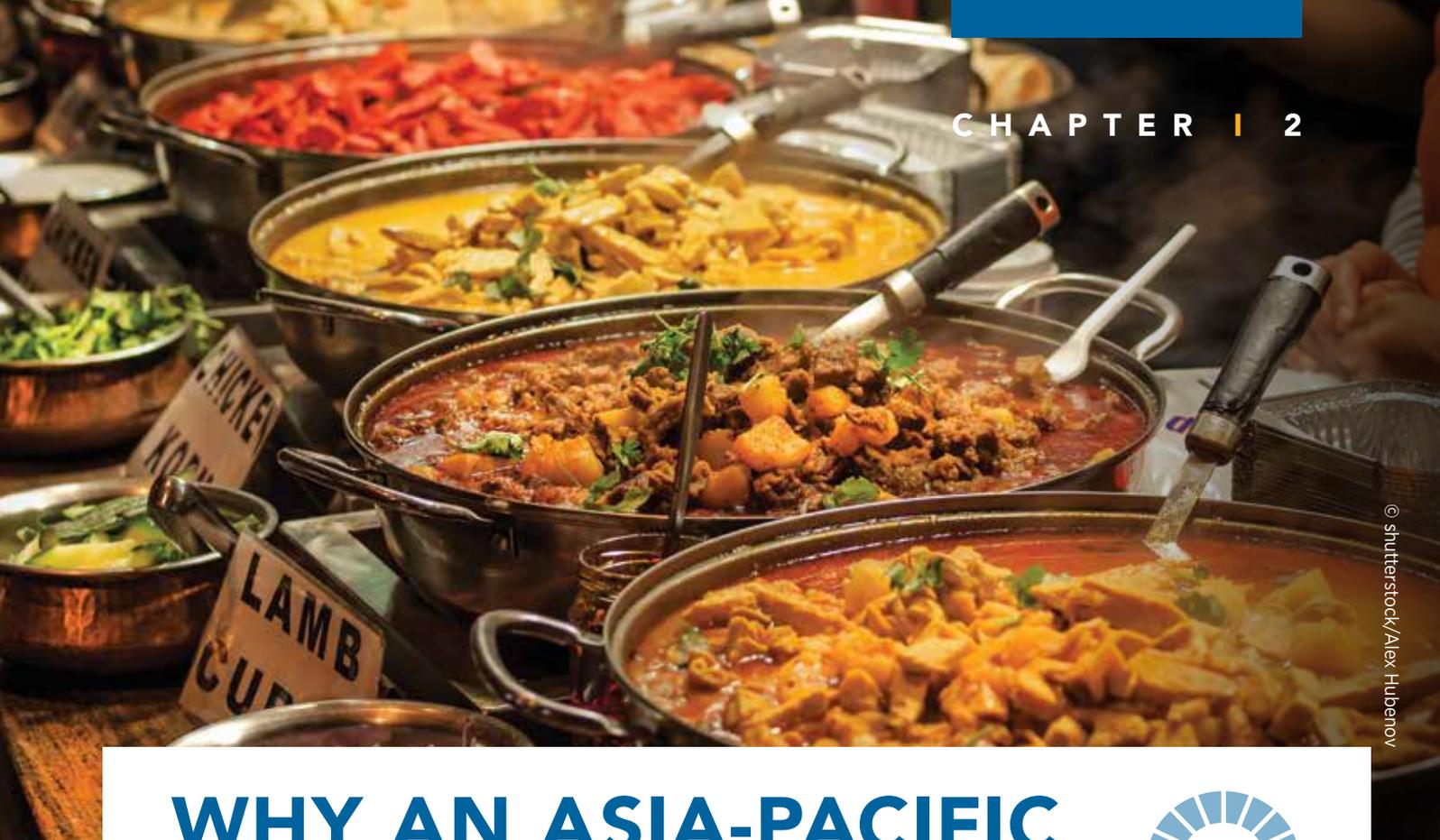
adapted to Asia-Pacific countries and educational systems and translated into national languages. Consultations can be facilitated with state and non-state actors, and with national agriculture and educational authorities on opportunities for implementation.

The FAO Regional Office for Asia and the Pacific can enable an FLW strategic approach in the region by working with governments to improve data through strengthening national and regional statistical capacity, and identifying and analysing food loss and waste critical points. FAO can also work with governments to translate data knowledge into actionable policy development support, and facilitate multi-actor consultations. This could include linking with the Association of Southeast Asian Nations (ASEAN), the South Asian Association for Regional Cooperation (SAARC), and APEC in raising awareness on the topic for political support, academia and the private sector.

The Asia and Pacific region offers opportunities for shared inter and intraregional learning through exchanging experiences and good practices based on the varying levels and degrees of experience that can be tailored to rural and urban priorities. A variety of key players in the region can be useful partners for the implementation of political and strategic changes needed to achieve SDG target 12.3.



© shutterstock/kurumeko



WHY AN ASIA-PACIFIC FOOD LOSS AND WASTE STRATEGY?



2.1. The need for strategy and action in Asia and the Pacific

The United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) published the *Asia and the Pacific SDG Progress Report 2020*. The report draws attention to the region's gaps in data and performance on, among others, SDG target 12.3 target to “halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses” by 2030. The report said that, “despite significant progress on some goals such as quality education (Goal 4), without extra efforts, the region is likely to miss all 17 goals by 2030. In particular, the region needs to reverse trends on responsible consumption and production (Goal 12) and climate action (Goal 13)

where the region is going backwards.”¹⁴⁴

The 2018 FAO Conference for Asia and the Pacific highlighted the interest from the region's Member Nations on FLW. The 2020 FAO Conference underlined that “improving data collection on FLW is a priority for monitoring progress towards achieving the SDGs.”¹⁴⁵ At the same FAO Conference, governments recommended FAO “support Member Nations to improve mechanization, commercialization, diversification and climate-smart investments, reduce post-harvest losses and ease labour constraints which will be reinforced by innovations, digital technologies and transformation in food systems.”¹⁴⁶

The first Global Food Loss Index estimated that 13.8 percent of all food produced in 2016 was lost from the farm to the wholesale level. Regional estimates range from 5 to 6 percent in Australia and New Zealand to 20 to 21 percent in Central and South Asia.¹⁴⁷

It is of utmost importance to progress from assumptions to utilizing FLW data monitoring and reporting that can enable cost-benefit analyses and impact assessments. To date, policy development fora and literature have addressed, to some extent, links between FLW and estimated impacts on GHG emissions, nutrient losses, technological needs, and challenges to food safety and quality. General or partial equilibrium econometric models estimated FLW reduction impacts with high degrees of uncertainty and included no cost assumptions¹⁴⁸ – highlighting the lack of food supply chain data on FLW quantities, types, and cost-benefit analysis for prevention and reduction. Approaches that addressed cost-benefit analyses of food supply chain operations proved more effective for interventions on prevention and reduction.¹⁴⁹

A lack of FLW representative data for Asia and the Pacific is one of the limitations for improving policies and scaling up investments. To address these gaps, FAO provides technical support to countries on the Food Loss Index and, together with UNEP, on the Food Waste Index.

The FAO Regional Office for Asia and the Pacific can facilitate the conversation between state and non-state actors on how to connect the data points that would enable change through a better understanding of the dynamics between FLW and, for instance, food (in-)security and climate change. This could foster coherent multi-actor support and investments for FLW reduction.

Increasing public interest and awareness of the environmental impacts of FLW is a key driver for action. As FAO 2019 underscored, “the only global justification for reducing FLW is the objective of reducing greenhouse gas emissions; all FLW reductions can contribute, but interventions late in the supply chain may have the biggest impact.”

FAO can provide guidance and support for retailers, food services and consumers for food waste prevention and reduction.



Specifically, Asia dominates world vegetable production and consumption with more than 50 percent of both. FLW of fruits and vegetables in industrialized Asia and South and Southeast Asia has a high carbon footprint, mainly due to large loss and waste volumes occurring during production, post-harvest handling, storage and consumption. Additionally, rice dominates cereals FLW with 53 percent in industrial Asia and 72 percent in South and Southeast Asia.¹⁵⁰

About 70 percent of GHG emissions of rice FLW in industrial Asia and South and Southeast Asia comes from the production phase, given the high GHG intensity of rice production methods, combined with high FLW. Another example¹⁵¹ presents evidence on estimating changes in FLW¹⁵² from a baseline, and resulting impacts of reduction interventions and mitigation potential on emissions of GHGs. For instance, in Bangladesh, where there was an estimated 2 to 10 percent decrease in dairy food losses with emissions reductions of 11 770 tonnes of carbon dioxide, interventions also included measures on “messaging, recipes, and trainings to increase use of both fresh and processed/preserved dairy products at the household level using gender-sensitive approaches.”

Finally, Asia and the Pacific is home to most of the world’s smallholder farmers. Food losses represent a significant and recurring loss of income, and limits consumer access to nutrition.

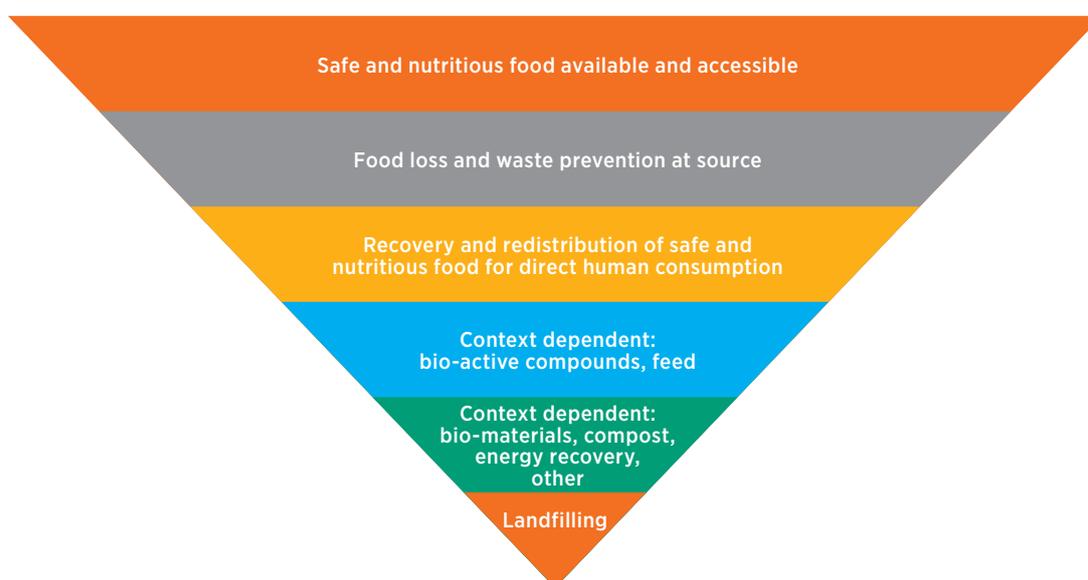
2.1.1. Policies, strategies and actions on FLW reduction

To inform and support preparation of the *FAO Regional Strategy on Food Loss and Waste Reduction in Asia and the Pacific*, regional FLW knowledge was mapped. This included in-depth national case studies in China, Thailand and Nepal to document and examine policies, strategies and actions.

Actions on improving food supply chain efficiencies, supporting food security and nutrition, and addressing climate change could incorporate elements of FLW prevention and reduction that would also strengthen their own impact. Other

appropriate waste management frameworks and concepts that should be considered include the food-use-not-loss-or-waste hierarchy, the '3Rs' (Reduce, Reuse and Recycle), extended producer responsibility, polluters pay principle, life cycle assessment, and sustainable consumption and production. The HLPE 2014 recommended the food-use-not-loss-or-waste hierarchy for the overall approach to FLW prevention and reduction. The priority is prevention, followed by recovery and redistribution to people in need, and after that redirecting for some related use such as bio- active compounds and feed, use for bio-materials sourcing, energy, or other extraction purposes and disposal as the last option.

FIGURE 8:
A food-use-not-waste hierarchy to minimize food loss and waste



SOURCE: Adapted from HLPE 2014

2.1.2. Regional overview of key players active in food loss and waste reduction

2.1.2.1. Asia-Pacific Economic Cooperation (APEC)

The 21 member economies of the Asia-Pacific Economic Cooperation (APEC) account for 39 percent of the world's population, 54 percent of world GDP, 53 percent of global cereal production, and 70 percent of fish production.¹⁵³

Countries in the region have a range of different FLW reduction targets and plans. The targets, and associated national-level programmes confirm the interest of governments in this issue and show that some countries are already investing in FLW reduction. The largest investments appear to be in the economies that have a high and growing level of consumer concern for the negative consequences of food waste. Hence, there is a strong need and scope for enhancing cross-country consultations, intraregional cooperation, and sharing of knowledge, lessons and good practices on FLW prevention and reduction in the region.

TABLE 2:
Food loss and waste reduction targets and reduction plans in Asia and the Pacific

NO.	COUNTRY	FLW REDUCTION TARGETS	FLW REDUCTION PLANS
1	Australia	To halve food waste by 2030. The target is aligned with SDG target 12.3.	The Australian Government's Food Waste Strategy was launched at the Food Waste Summit at Economy Level on 20 November 2017. The Australian Fight Food Waste Cooperative Research Centre is an AUD 33 million cash commitment and 10-year collaboration involving an increasing number of participants with the collective aim of reducing food waste throughout the supply chain, transforming unavoidable waste into innovative high-value co-products, and engaging with industry and consumers to deliver behavioural change.
2	China	To reduce FLW by 40% by 2020, and to reduce FLW by 13 mt 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.
3	China, Hong Kong SAR	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.
4	Japan	The recycling rate targets set by government in 2015 are manufacturers 95%, wholesalers 70%, retailers 55%, and restaurants 50%.	The Food Recycling Law, which was launched by the Ministry of Agriculture, Forestry and Fisheries, and Ministry of the Environmental in 2001.
5	Malaysia	To reduce FLW by half by 2030.	The reduction of FLW policy is part of the 3rd Action Plan for Nutrition in Malaysia 2016–2025, and Nutrition Research Priorities for the 11th Malaysian Plan, 2016–2020.
6	Philippines	Rice and corn: the target is 2% post-harvest loss reduction in 2017 for the next five years. Fisheries: the target is 10% reduction of fisheries post-harvest losses by 2020.	Senate Bill 357, or the Zero Food Waste Act, targeting zero food waste. The "Be responsible" Program is an economy-wide advocacy campaign to manage rice consumption by reducing waste and promoting better health through rice, which is the staple food. The 10-Point Agenda of the Department of Agriculture includes the establishment of strategic post-harvest facilities across crops.

NO.	COUNTRY	FLW REDUCTION TARGETS	FLW REDUCTION PLANS
7	Singapore	Overall recycling rate of 70% by 2030.	Adoption a food waste management approach, beginning with source prevention and reduction, followed by promoting the redistribution of unsold/excess food, and lastly, recycling/treating. Collection and co-digestion of 400 tonnes segregated food waste with used water sludge per day at the Integrated Waste Management Facility starting from 2024.
8	Viet Nam	Government set targets for reducing post-harvest loss rates: rice, from 11–13% to 5–6%, maize from 13–15% to 8–9%, and aquaculture from 20% to 10% in 2020. Decision 1003/QD-BNN-CB dated 13/5/2014 by the Ministry of Agriculture and Rural development: By 2020, increase the added value of agro-forestry and fishery products by an average of 20%, and reduce post-harvest losses of agricultural and fishery products by 50%.	The government enacted a policy of financial incentives for businesses, farmer cooperatives, and farmers for investment in agricultural facilities to reduce post-harvest loss. The Government has several policies with the objective of facilitating the private sector to invest in technological innovation, increase the proportion of in-depth processed products, ensure food safety, competitive prices, and market requirements. Also to invest in advanced technology for manufacturing high value-added products from agricultural waste.

SOURCE: APEC Survey Report on Feasible Solutions for Food Loss and Waste Reduction APEC Agricultural Technical Cooperation Working Group APEC Policy Partnership on Food Security August 2018.

It is important to strengthen partnerships among the public and private sectors of APEC^{xxv} member economies to develop policy recommendations and solutions for reducing FLW, as well as enhancing food quality and safety to contribute to food security in the region. Multiple food security challenges should be considered: population and income growth, urbanization, shifting diets, natural resources constraints and climate change.

2.1.2.2. Association of Southeast Asian Nations (ASEAN)

Post-harvest losses are very high in Southeast Asia. FAO estimated losses in rice of between 10 percent and 27 percent, and losses in fruit and vegetables higher than 20 percent, exacerbated by the warm, humid climates.¹⁵⁴ The 2016–2020 Initiative for the Association of Southeast Asian Nations (ASEAN) Integration (IAI) Work Plan III¹⁵⁵ addresses contexts with currently limited application of

post-harvest technologies and gaps in training of farmers. In 2018, it assessed losses and technological solutions for mango in Cambodia, Lao People’s Democratic Republic and Myanmar, and for dragon fruit in Viet Nam.¹⁵⁶

Some of the Asia and the Pacific Member Nations are developing policies concerning FLW directly or indirectly. For instance, one of the first challenges for food waste management is to collect food waste separately from other types of solid waste. Some countries, such as Japan, Palau, have started to address this. However, many others could scale-up efforts with a concrete target on food waste prevention. FAO could provide targeted technical support to urban areas in the region.

Several countries in Asia and the Pacific are taking a wide variety of measures to address FLW, from policy incentives to supply chain interventions and consumer awareness campaigns.

^{xxv} APEC drafted a methodology for food losses assessment.

2.2. Country-level approaches to food loss and waste

2.2.1. China

As the largest developing country, China attaches great importance to the 2030 Agenda. The “China’s National Plan on Implementation of the 2030 Agenda for Sustainable Development” is aimed at analysing challenges and opportunities, and providing specific plans for the implementation of the 17 SDGs and their 169 targets.

To address SDG target 12.3, China is using policy guidance, technological innovation and changing consumption models to focus on per capita food waste reduction from retail to households and food losses during production, processing, transportation and supply.

Several government ministries and agencies in China are relevant for policy-making in food waste reduction and treatment, such as the National Development and Reform Committee, and the Ministry of Agriculture. For example, while the

Ministry of Housing and Urban-Rural Development regulates the collection and transportation of food waste, the Ministry of Environmental Protection regulates its treatment. Scope exists for closer coordination and improved policy coherence, which could include a high-level committee under the State Council. Other public agencies taking part in national policies formulation and implementation on FLW are the State Administration of Grain, the National People’s Congress, the Political Bureau of Central Committee of the Communist Party of China, the Ministry of Commerce and the Ministry of Industry and Information Technology.¹⁵⁷

Food waste management systems are often operated under the responsibility of local governments and municipalities. China implemented several policies and laws promoting comprehensive reduction and (re-)utilization of food waste. Two groups of national policies and regulations can be identified: those that address FLW minimization and those that deal with treatment.

TABLE 3:
Regulations, policies and plans for food waste reduction and treatment in China

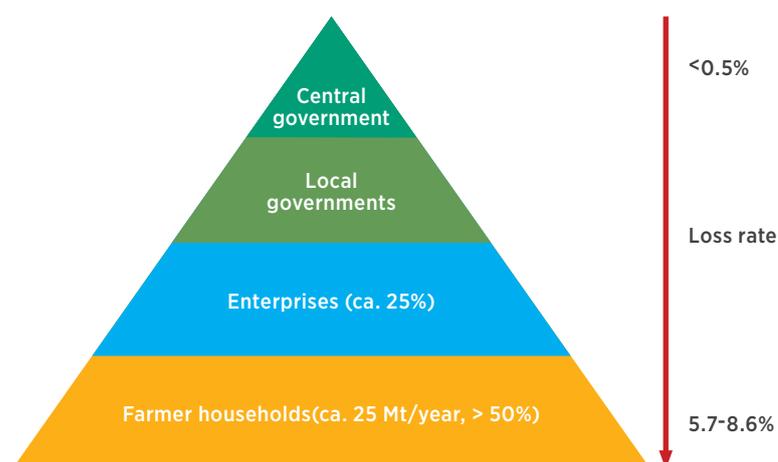
Regulation, policies and plans for food waste reduction	Main contents	Date of issue	Issuing division
Outline of the programme for Mid and Long-term National Grain Security (2008–2020)	Major targets and countermeasures to enhance the storage, processing and retailing system of grain	2008/11/13	State Council
Planning for 50 Mt New Production Capacity of Grain (2009–2020)	Countermeasures and targets to reduce both agricultural losses (1–2% reduction of insect infestations by 2020) and post-harvest losses	2009/11/3	National Development and Reform Committee
Administrative Rules on Storage and Warehousing in Grain and Oil Industry	Detailed measures and reporting regulations on grain storage	2009/12/29	National Development and Reform Committee

Regulation, policies and plans for food waste reduction	Main contents	Date of issue	Issuing division
Outline of the Programme for National Pig Slaughtering Industry (2010–2015)	Major targets for improving efficiency in slaughtering, processing and retailing, and market concentration of the slaughtering industry	2009/12/31	Ministry of Commerce
State Council Circular to further Enhance Grain Saving and Food Waste Reduction	Detailed countermeasures on organizing, educating, supervising, and inspecting the work on food waste reduction in China	2010/1/18	State Council
Development Plan (2011–2020) for a Grain-Saving Animal Husbandry Industry	Short-, mid- and long-term targets for non-grain fodder production	2011/12/21	Ministry of Agriculture
Development Plan (2011–2020) for the Vegetable Industry	Countermeasures for reducing post-harvest losses of vegetables	2012/1/16	National Development and Reform Committee and Ministry of Agriculture
Eight Rules on Improving Style of Work and Enhancing Close Ties with the People	A campaign against official extravagances and governmental reception meals at public expenses	2012/12/4	Politburo
Plan of action for saving food through the entire chain, including grain production, storage, transportation, processing and consumption	It aims to establish a standard and a monitoring system for cutting food loss and waste	2021	Central Committee of the Communist Party of China and the State Council, China's Cabinet
Administrative Rules on Municipal Solid waste	Detailed regulation on municipal food waste clearance	2007/04/28	Ministry of Housing and Urban-Rural Development
Food Security Law	Regulation of safety issues of food waste treatment	2009/02/28	National People's Congress

China's grain storage appears as a pyramid structure. Farmer households store over 50 percent of grain, commercial enterprises 25 percent, and local and central governments the remaining 25 percent.¹⁵⁸ While the governmental granary shows a low loss rate of less than 0.5 percent,

close to the level in industrialized countries, high storage losses are found at the farmer level for household consumption, such as half a year to a year, or while the farmer waits for a selling opportunity or a rise in prices.

FIGURE 9:
Pyramid structure of grain storage and associated loss rate in China



SOURCE: Liu, 2013.

*The Food Security in China report from The State Council Information Office of the People's Republic of China*¹⁵⁹ states that the country will encourage grain conservation and reduction of losses through “publicity and education activities to enhance public awareness of food conservation, contain unnecessary consumption, reduce food waste.” Large amounts of food are wasted at the consumer stage (over 50 mt of grain) compared to losses and waste at the pre-consumer stage (35 mt of grain, excluding

the agricultural stage).¹⁶⁰ According to China's State Administration of Grain, in 2014, 35 percent of the country's annual food production was lost or wasted. A target under this objective is that by 2020 the country should advance the building of smart grain depots and measures that address oil-bearing crops. “At the end of 2018, around 1 400 postharvest service centres and over 60 000 granaries using scientific storage methodology had been established and made available to farmers.”¹⁶¹

TABLE 4:
Food losses during storage in China, 2011

Food	Loss (%)	Volume of loss (Mt)
Grain	7-10	15-22.5
Vegetables	15-20	100
Fruits	10-15	14
Potatoes	15-25	16

Food waste at the consumer stage is expected to continue to increase due to increasing urbanization, affluence and changing lifestyles.¹⁶² Therefore, in 2013, the country launched the “Clean your plate campaign.” Urban areas and the catering and

restaurant sector are both a source and a solution to this challenge. In 2020, the anti-food-waste campaign attracted the attention of millions of users on Weibo.¹⁶³

BOX 18: **China: Clean your plate campaign for food services and consumers' food waste reduction**

In 2013, China launched its first “Clean your plate” campaign. In 2020, President Xi Jinping launched a new version of the campaign, stating that food waste in China is “shocking and distressing.” He quoted a 9th-century poet: “Who knows that every grain on the plate comes from the hard work of farmers?”

The campaign includes public and private food services, and household consumption. The Ministry of Education created an action plan for schools nationwide that involves both canteens and students. Additionally, restaurants have launched their own food waste prevention and reduction plans, such as the Wuhan Catering Industry Association’s “N-1” system, in which a group of diners may order only as many dishes as the number of people in their party, minus one.

A team of researchers from the Chinese Academy of Sciences highlighted the scale of food waste. The team surveyed around 7 000 tables and 366 restaurants, interviewed hundreds of people, collated 7 500 questionnaires and weighed 32 000 dishes. The findings were that 17 to 18 million tonnes of food are wasted in China every year, enough to feed 30 to 50 million people.¹⁶⁴

The government promoted the 2013 “Clean your plate” campaign by announcing a ban on lavish government-sponsored banquets.¹⁶⁵ Many restaurants started to offer smaller portions at a lower price or encourage customers to take a doggy bag.¹⁶⁶ Caterers were also forbidden to set minimum consumption rules according to the Catering Industry Operation and Management Regulation released by the Ministry of Commerce.

The “Beijing-Tianjin-Hebei Restaurant Industry Development Forum”, a group of cooking associations, jointly issued the “Proposal of Beijing-Tianjin-Hebei catering industry on green catering, clean your plate campaign”. Additionally, the Fuzhou Restaurant Association advocated flexible ordering, providing measures such as “Half Price” and “Hot Dish Platter”.

The Chengdu Food and Beverage Association and the Chengdu Consumer Society launched the “Civilized Table Action”. The Jiangsu Food Industry Association issued “Jiangsu Restaurant Enforce to Thrift and Anti-Food Waste Petition”. It called on provincial caterers to fulfil their social responsibility.

Student Associations participated in this campaign. They pushed for an increased symbolic value of food. According to CCTV on 27 May 2017, about 70 percent of the students had leftover food waste at the universities’ canteens. Solutions such as “punching cards for a clean plate” and other anti-waste behaviours were promoted as part of building a low-carbon campus. Many schools have also launched investigations with the aim of finding the reasons that lead to waste.

SOURCE: <https://www.nycfoodpolicy.org/food-policy-center-china-clean-plate-campaign/>;
http://english.igsnr.cas.cn/ue/News_Multimedia/201803/t20180327_191104.html;
<https://www3.nhk.or.jp/nhkworld/en/news/backstories/1297/>

2.2.2. Australia

In Australia, food waste^{xxvi} accounts for a yearly economic loss of about AUD 20 billion.¹⁶⁷ The total cost of agriculture food losses to farmers is AUD 2.84 billion, while 2.2 million tonnes of food is wasted from the commercial and industrial sectors, and 3.1 million tonnes of food is wasted at the household level, costing the average household between AUD 2 200 and AUD 3 800. In 2016, the government convened a food waste summit and developed a National Food Waste Strategy.

The National Food Waste Strategy provides a framework to support collective action toward halving Australia's food waste by 2030. Four priority areas have been developed following consultations with industry, business, government, academia and the not-for-profit sector.

1. Policy support

- Establishing a National Food Waste Baseline and methodology to measure progress
- Identifying areas to target investment
- Establishing a voluntary commitment to reduce food waste
- Enabling legislation to better support food waste reduction and repurposing

2. Business Improvements

- Identifying areas for improvement
- Supporting technology adoption
- Encouraging collaboration
- Normalizing food waste considerations into business practices

3. Market development

- Identifying food waste composition and nutritional value to develop new markets
- Encouraging innovation
- Connecting food waste sources to users

4. Behaviour changes

- Changing consumer behaviour
- Engaging the workforce on food waste

To achieve success in these areas, the government urged all Australians to contribute. The government made an initial investment of AUD 1 million to implement the strategy. The retail and food processing sectors are also working to address food loss and waste. The food processing industry's premier body, the Australian Food and Grocery Council, has a target to reduce waste to landfills by 40 percent by 2020. There are strong incentives for food processors and retailers to reduce their food waste. These include increased efficiency and profitability and opportunities for businesses to stand out from their competitors.

A substantial amount of safe and nutritious food is diverted from landfills through three major food recovery and redistribution services – the Fareshare food bank, OzHarvest and SecondBite. Major grocery retailers, such as Coles and Woolworths, which account for around 70 percent of the supermarket sector, have partnered with these organizations. These partnerships mean that retailers can meet their food waste reduction goals while the charities are able to alleviate food poverty. Industry is also exploring with how different types of packaging can reduce food waste, waste-to-energy options, and conversion of food waste into alternative types of animal feed.

In 2020, an independent new governance body with the objective to cut FLW was launched with AUD 4 million in seed funding. It will work for “all parts of the farm-to-fork food supply chain – from farmers, food manufacturers and wholesalers through to retailers, hospitality, households and food rescue organisations, as well as create new jobs in food innovation,” said the assistant minister for waste reduction and environmental management. The new body will operate in partnership with the Department of Agriculture, Water and the Environment.¹⁶⁸

The Australian Fight Food Waste Cooperative Research Centre aims to improve competitiveness, productivity and sustainability, and is aligned with the Food and Agribusiness Sector Competitiveness Plan prepared by Food Innovation Australia Ltd.¹⁶⁹ In 2018, the Fight Food Waste Cooperative Research Centre attracted a 10-year, AUD 30 million programme grant.

^{xxvi} In this case food waste is accounted for from production to households.

2.2.3. Thailand

The concept of sustainable consumption and production (SCP) has been integrated into the five-year National Economic and Social Development Plan (NESDP). As with previous plans in recent years, the National Economic and Social Development Plan 2017-2021, puts the “Sufficiency Economy” philosophy of the late King Bhumibol Adulyadej (1927–2016) at the heart of the national development agenda, and provides a policy framework for identifying strategic directions for Thailand’s sustainable social and economic development within a healthy environment. Key strategies in the 12th National Economic and Social Development Plan stress the following areas: creating a justice society and reducing social inequality, capacity development, strengthening economic potential sustainability and enhancing competitive edge, promoting sustainable consumption and production, maintaining domestic security and promoting good governance.

The Ministry of Natural Resources and Environment is responsible for natural resources and environmental issues, including SCP. Various departments within this ministry have been moving forward with SCP issues. Led by the Office of Natural Resources and Environmental Policy and Planning, the Ministry of Natural Resources and Environment and 27 government agencies have formed the Subcommittee for SDG 12 under the Steering Committee on Natural Resources and Environment for the Implementation of SDGs.

Thailand’s National Committee for Sustainable Development has put forward the “The Sustainable Consumption and Production Roadmap 2017–2036,”¹⁷⁰ which was built on the pre-existing Thailand SCP Roadmap developed under the SWITCH-Asia Programme of the Thailand-EU Policy Dialogues Support Facility. The goals of the roadmap are in line with the SDGs. The SCP Roadmap is composed of the following three strategies:

1. Lifting Thai society to meet the sustainable production strategy

2. Lifting Thai society to meet sustainable consumption strategy
3. Lifting Thai society to apply supported factors for sustainability strategy

In addition to the work of the Office of Natural Resources and Environmental Policy and Planning, the Pollution Control Department has been implementing green public procurement since 2005 to create a market for environmentally friendly products and services. The Department of Environmental Quality Promotion has implemented a public awareness campaign to change people’s behaviour towards more environmentally friendly and sustainable choices.

Furthermore, the Office of International Cooperation on Natural Resources and Environment, as the National Focal Point of the 10-Year Framework of Programmes on Sustainable Consumption and Production Patterns (10YFP), with assistance from the Thailand-EU Policy Dialogues Support Facility, developed a draft Five-Year Action Plan, from 2018–2022, for the implementation of the 10-Year Framework. The plan contributes to the enhancement of the implementation of SDG 12 and the 10-Year Framework through executing the SCP Roadmap and promoting participation of all stakeholders.

Thailand has launched its framework on SCP 2017–2036 and established its 10-year action plan. Enhancing sustainable food systems is one of its six targets. The specific goals under this target include acquiring national data on food losses and decreasing food losses through the food supply chain by 5 percent per year from 2020.

The Department of Pollution Control and the Department of Environmental Quality Promotion lead SDG target 12.3 activities under the Ministry of Natural Resources and Environment. Bangkok waste management strategies focus on the 3Rs principle of reduce, reuse and recycle. It was estimated that 52 percent of food waste can be turned into compost, 10 percent can be recycled and 38 percent can be regenerated into energy sources.



The post-harvest unit of the Ministry of Agriculture and Co-operatives (MoAC) is strongly engaged in food loss issues. Various support mechanisms are in place for specific commodity loss reduction, such as financing rice drying and storage. This ministry is also engaged in researching the levels of losses in key commodities, and food waste, both with support from FAO. The government has also set up a national food loss and waste committee, which

is now carrying out national baseline studies with partners mainly from government and academia, with technical assistance from FAO on food loss measurement. Since 2016, additional efforts reinforcing the capacity of the National Statistics Office regarding SDG target 12.3.1 monitoring and reporting have been supported by the FAO Technical Cooperation Programme.

BOX 19: Thailand: Direct measurement of banana and mung bean loss

At the 28th Session of the Asia and Pacific Commission on Agricultural Statistics, held in Bali, Indonesia, from 10 to 14 February 2020, FAO and Thailand's Department of Agriculture presented the results of an exercise in the direct measurement of losses of mung beans and bananas.

The direct measurements for mung beans concerned ten farmers from five villages (two farmers in each village) in Nakhon Sawan province and four millers in Kampaengphet province. Results show that losses at harvest were 7.08 percent.

For bananas, direct measurements concerned five farmers in five villages in Pathumthani province and three packinghouses in the same province. Results were that farmers' losses from damage by cutting, diseases, and animals such as birds reaches 2.81 percent, and packing house losses were 1.68 percent.

The FAO food loss analysis methodology provides that kind of relevant data to develop understanding at the national level. However, this exercise is basic for the statistical level work necessary for the Food Loss Index, considering the high financial, time and human resource costs for extensive direct measurement of food losses.

SOURCE: Assessment of Harvest and Post-Harvest Losses of Banana and Mung bean Commodities in Thailand. PowerPoint presentation, 2020. <http://www.fao.org/3/ca7869en/ca7869en.pdf>

2.2.4. Nepal

Nepal has committed to undertake the Zero Hunger Challenge (ZHC) of the 2012 Rio+20 Conference on Sustainable Development. Nepal adopted the ZHC as part of a national vision for preparing its National Action Plan to eradicate hunger by 2025. The plan emphasizes the establishment of storage facilities, preservation equipment, packinghouses, information and communication technologies to minimize loss at each step of the supply chain.

The Food Research Division of the Nepal Agricultural Research Council is responsible for formulating strategies for minimizing post-harvest losses. Losses varied between 20 and 30 percent for apples, between 15 and 20 percent for citrus, between 10 and 15 percent for tomatoes and between 10 and 15 percent for cauliflower.¹⁷¹ FAO has also supported data collection as well as piloting solutions to food losses reduction for cauliflower in Nepal.¹⁷²

The major objective of National Action Plan on Zero Hunger is to ensure adequate food for all, including through strengthening sustainable production processes for accelerated growth of the agriculture sector, improving food governance services for effective management of hunger and malnutrition, and fostering rights-based food security.

The National Action Plan targeted, among other things, an increase in investment in agriculture, the development of physical infrastructure and agri-business, an increase in employment opportunities (including for youth), and support

for smallholder and landless producers through access to productive resources. From 2014 to 2018, FAO provided technical support for the Agriculture and Food Security Project that was initiated to address food security and reduce health risks and food risks among vulnerable groups. The evaluation of this project found that it exceeded all of its performance targets. It reached 656 245 poor people (target 560 000), approximately 603 000 of whom were women (target 392 000), it released 30 technologies (target 29), it conducted 6 580 field trials (target 4,000), and produced 583 metric tonnes of source seeds (target 540 metric tonnes).¹⁷³

In continuation of the Agriculture and Food Security Project, the Ministry of Agriculture and Livestock Development is implementing the Food and Nutrition Security Enhancement Project¹⁷⁴ from 2018 to 2023 to improve agricultural productivity and nutrition practices. The FAO is providing technical support to reach the project's objectives "to enhance climate resilience, improve agricultural productivity and nutrition practices of targeted vulnerable communities in the selected areas of Nepal." The project targets the following districts: Dhading, Gorkha, Dolakha, Sindhupalchok, Saptari, Siraha, Mahottari and Dhanusha, and aims to reach approximately 65 000 direct beneficiaries, of which at least 65 percent are expected to be women.¹⁷⁵

There is a strong need of post-harvest management and improvements in food loss measurement, supported initially by FAO technical assistance in 2018/2019 (Annex 3).





© shutterstock/Elena Yakusheva

2.3. Food loss and waste work by FAO in Asia and the Pacific

In April 2013, the UN Deputy Secretary-General launched the Zero Hunger Challenge in Asia and the Pacific. Subsequently, the UN Regional Thematic Working Group on Poverty and Hunger developed the Regional Guiding Framework for Achieving Zero Hunger in Asia and the Pacific. The Regional Initiative on Support to the Zero Hunger Challenge in Asia and Pacific was formulated in alignment with the FAO's Strategic Objective.

The High-Level Multi-Stakeholder Consultation on Food Losses and Food Waste in Asia and the Pacific Region was convened in Bangkok, Thailand, 27 to 28 August 2013, by the FAO Regional Office in Asia and the Pacific in collaboration with the Asian Institute of Technology (AIT). The consultation brought together representatives of the donor community, senior government officials responsible for agriculture, private sector representatives, researchers and academics, and school children and teachers. The consultation culminated in the launching of the Save Food Asia-Pacific Campaign implemented by FAO mainly in Thailand.

FAO has also implemented a number of projects supporting the improvement of measurement and reporting for SDG target 12.3.1 in Thailand and Nepal, and held a regional-level training course for statisticians on SDG measurements in Japan in 2019. FAO provided support for the development of a number of papers in the region including a

white paper for parliamentarians in the Philippines, and support for a 2020 FLW APAC meeting organized by the Government of Indonesia. FAO also provided support for a range of programmes for specific country, regional and commodity improvements in post-harvest management, including with ASEAN under its five-year work plans in 2018, and with SAARC in Thailand on banana and mung bean losses. In Myanmar, FAO supported the development of a national FLW baseline development and methodology on food waste reduction and rice losses from 2019 to 2021. In Sri Lanka, it supported a project on urban food waste, and in Malaysia, an ongoing project on improved loss measurement and reduction. A new programme is also starting on grain/cereal loss reduction in Afghanistan and Myanmar in 2020/2021. FAO supported case studies on fish loss assessment of small-scale fisheries in Indonesia in 2014,¹⁷⁶ and is implementing Technical Cooperation Programme projects (2020/2021) on reducing fish losses in the capture fisheries supply chain in Bangladesh and Sri Lanka. Assessment of losses in small-scale fisheries is guided by the fish loss assessment methodology¹⁷⁷ developed by FAO.

FLW is already mainstreamed into many of the larger regional and national projects on sustainable food systems and value chain development, including in Afghanistan, Pakistan, Papua New Guinea and Bangladesh.

2.4. Analysis of food loss and waste strategy in Asia and the Pacific

A tailored FLW strategy is needed for the Asia and the Pacific region, one that considers the co-existence of FLW in many economies. The region offers opportunities for sharing lessons learned, and knowledge and practices based on the varying levels and degree of inter- and intra-regional experiences.

With the ongoing country and regional-level work by FAO on the Food Loss and Food Waste Indices (SDG indicators 12.3.1.a and SDG 12.3.1.b), the momentum and interest of countries increased for support in the rollout of the indices and related methodologies in the region. Better data on quantities and types of FLW would allow progress on the understanding and identification of the most adequate solutions to minimize the impacts on human nutrition, climate change, and at the micro and macroeconomic levels.

FAO could strengthen the technical support for statistical training and field-level work for the identification and analysis of critical food loss and waste points through available methodologies to facilitate informed actions by decision-makers on investments needed and their returns. This is also essential to target food loss data collection resources where losses are the most prevalent. Specialized food systems capacity is required to respond and support countries to deliver their SDG target 12.3 objectives.

Partnerships with regional organizations such as ASEAN or APEC may provide the best route for engaging countries at a higher political level to effect changes and collaboration through multi-sectorial FLW approaches. For instance, ASEAN worked on agricultural innovation under the ASEAN Integrated Food Security (AIFS) Framework¹⁷⁸ and the FAO Regional Office for Asia and the Pacific can support enhanced investments based on the ASEAN Guidelines to Promote Responsible Investment in Food, Agriculture and Forestry.¹⁷⁹ These are grounded in the CFS Principles for Responsible Agriculture and Food Systems, which contains Guideline 5: Conserve and

sustainably manage natural resources, in particular ASEAN's forests, by "minimizing pre- and post-harvest loss and waste, increasing production efficiency, and the productive use of waste and by-products, including by investment in transport and storage infrastructure, partnerships for technological diffusion and research."¹⁸⁰

FAO played a facilitating role in increasing FLW awareness and supporting national initiatives on reduction including through mobilizing social media. WEIBO held an FLW awareness event in 2017 that attracted over one million users. In 2013, FAO implemented the Save Food awareness raising campaign, mainly in Thailand.

The country examples provided from Australia, China, Nepal and Thailand, and state and non-state experiences could be shared widely in the region through a regional FAO-facilitated FLW platform to enable action and scaling up of solutions. China, through its "Clean your plate" campaign, identified consumers as drivers of change in food waste reduction, also engaging the private sector. Thailand has been forward thinking in establishing specific goals and objectives for SDG target 12.3 under the Sustainable Consumption and Production Programme. With increased public awareness of environmental issues, the Thai government is also promoting improved food choices and environmental considerations related to the consumption and disposal of food.

Enhanced awareness of the need for action on FLW reduction is useful and needs to be reinvigorated, as per the Nepal experience. Core planning, such as the National Action Plan under the national Zero Hunger Strategy, has broad food security targets that link with FLW prevention and reduction.

These examples provide useful information and options for consideration by other countries in the region. A cross-cutting challenge is to address two of the major problems associated with FLW: natural resources extraction and GHG emissions that contribute to climate change.





FOOD LOSS AND WASTE, CLIMATE CHANGE AND THE ENVIRONMENT



3.1. Introduction

In 2020, the Intergovernmental Panel on Climate Change (IPCC) published the “Climate Change and Land” special report in which global FLW is estimated to cause between 8 and 10 percent of the emissions of the gases responsible for global warming during 2010–2016.¹⁸¹ The yearly global environmental impact of FLW includes a carbon

footprint of around 500 million tonnes CO₂ eq. (690 kg CO₂ per capita), a water footprint of 19 km³ (26 m³ per capita) and a land footprint 95 million hectares (1 300 m² per capita, and around 38 percent of total energy consumption of global food systems.

TABLE 5:
Main global environmental impacts of food loss and waste

Environmental impacts	Unit	Global	OECD countries	Non-OECD countries
GHG emissions	Gt CO ₂ eq	3.49	0.75	2.74
Land occupation	Million ha	0.90	0.21	0.70
Water use	km ³	306	24	282
Soil erosion	Gt soil lost	7.31	1.00	6.31
Deforestation	Million ha	1.82	0.16	1.66

SOURCE: FAO, 2015.

FLW represents inefficiency and lost potential to address global food insecurity and malnutrition. It also presents a significant environmental and climate challenge. Each stage of agricultural production involves GHG emissions from land-use change, fuel consumption and other operations, including methane emissions from landfilling food waste.

FLW have significant embedded emissions and represent a major contributor to climate change, accounting for around 8 percent of global anthropogenic GHG emissions. FAO estimated that nearly 30 percent of the world's agricultural land is used to produce food that is ultimately never consumed by people.¹⁸² The lost and wasted resources embedded in FLW can also be considered indicative of unnecessary strain on ecosystem services.

At the policy level, the 2030 Agenda and the Paris Agreement, among other instruments, provide the framework to develop mutually reinforcing targets and reporting systems at the national level for sustainable management of environment and natural resources. Action in support of SDG target 12.3 can contribute to achieving SDG 6 (sustainable water management) through improved utilization of water resources in food production, SDG 11

(sustainable cities and communities) through improved management of food environments, SDG 13 (climate change) through reduction in emissions embedded in FLW, SDG 14 (marine resources) and SDG 15 (terrestrial ecosystems, forestry, biodiversity) through more sustainable utilization of fisheries and other natural resources underpinning food production (FAO, 2019).

Developing mutually reinforcing SDG targets supports efforts to better measure and monitor national FLW, providing a basis for more informed and enhanced actions over time. Improved data and statistics on the quantities of food being lost and wasted will help measure progress towards the achievement of SDG target 12.3, and other commitments related to reducing impacts on the environment and climate change, in particular under SDG 13. Integrated and complimentary targets require closer collaboration between national statistical authorities, and environmental and food/agriculture national authorities.

FAO can play a facilitative role for national governments in this regard. For instance, FAO provided comprehensive background information on SDG target 12.3 and FLW technical considerations for the Act on Promoting Food Loss Reduction (Act No. 19 of 2019) passed by Japan.

BOX 20:
Japan: Divert food waste from landfill with consumers as key change makers

In September 2020, the World Bank launched the Sustainable Development Bonds totalling USD 500 million with the Norinchukin Bank, a national financial institution for agricultural, fishery and forestry cooperatives in Japan that also promotes initiatives that address FLW, as the sole investor. Financing includes USD 4.6 billion of International Bank for Reconstruction and Development (IBRD) lending to middle-income countries to address FLW, with investments in infrastructure, access to markets and logistics, and waste management.

In May 2019, Japan's parliament passed the Act on Promoting Food Loss Reduction (Food Loss Act; Act No. 19 of 2019) that took effect on October 1, 2019 as part of the government's plans in response to SDG target 12.3. "The Food Loss Act obligates the national government to establish a basic policy to cut back on food waste, and local governments to devise their own action plans (Articles. 3, 4, 11-13). The national and local governments are to educate consumers and businesses (Article 14). The Act directs national and local governments to take measures to facilitate activities of non-governmental organizations to collect usable food that would be wasted and distribute it to people in need and disaster victims (Article. 19)." The Doggy Bags Dissemination Committee is informing the public about the idea. The Consumer Affairs Agency publicizes activities on its food loss education web page. Businesses are now also utilizing artificial intelligence to better manage food.

The Japan Food Recycling Law was enacted in 2000 and endorsed in January 2001 under the joint jurisdiction of the Ministry of Environment and the Ministry of Agriculture, Forestry and Fisheries. The Law, amended in 2007, (i) provides guidance and advice to food-related business operators; (ii) sets food waste recycling and reduction targets for each sector of the food supply chain; (iii) imposes mandatory food waste reporting – together with reporting of waste reduction efforts – on food-related businesses that produce 100 tonnes of food waste or more per year; and (iv) targets also include inedible by-products, which tend to be difficult for manufacturers to reduce.

Delivery time/date marking: The Ministry of Agriculture, Forestry and Fisheries worked with businesses to reduce food waste by encouraging the relaxation of strict delivery deadlines. It permitted the extension, under food safety and quality protection, of expiry dates and, in the case of products with a shelf-life of over three months, the substitution of expiry date labelling with the expiry month. It encouraged improvements in packaging to extend product shelf-life. The No-Foodloss Project was launched in 2013 by the Japanese government to support safe and nutritious food waste reduction along the food supply chain, including support to food banks and calls for "no leftovers" and "Mottainai" (no waste) campaigns in restaurants.

SOURCE: <https://www.worldbank.org/en/news/press-release/2019/09/20/pressrelease20190920norinchukinbanksdbflw>;
<https://www.loc.gov/law/foreign-news/article/japan-diet-passes-new-act-aimed-at-reducing-food-loss/>

3.2. FLW and climate change in Asia and the Pacific

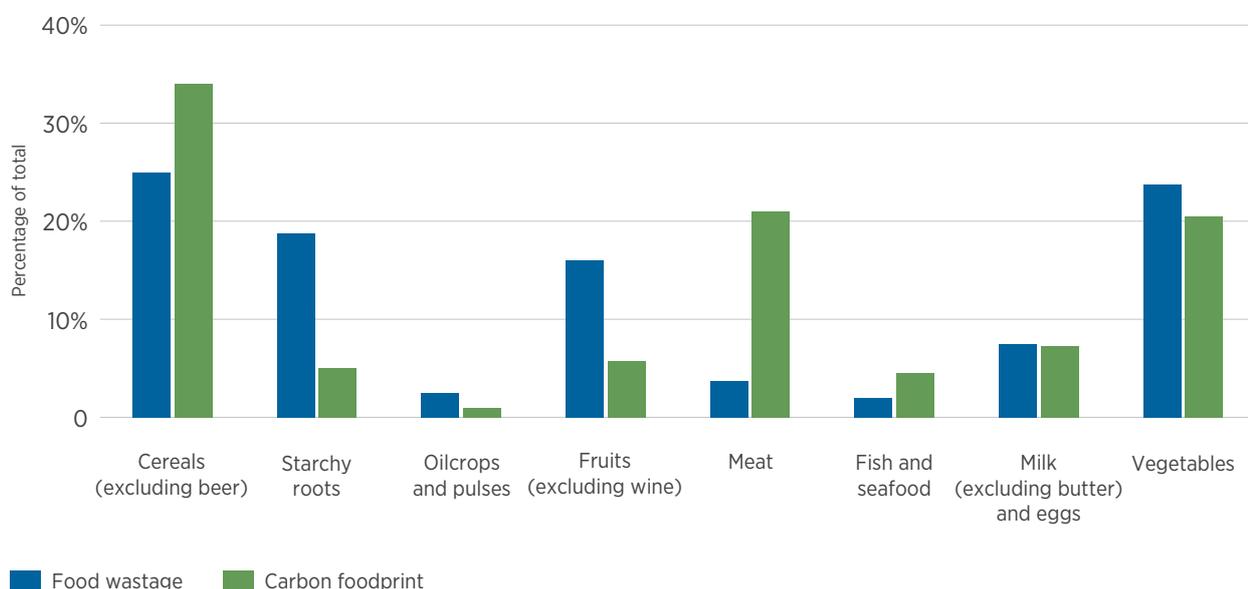
Climate change is a threat to livelihoods, food security and food systems in Asia and the Pacific. The relationship between FLW and climate change is not only a matter of emissions. Changes in climate and average weather conditions over time can have a range of implications for changes in the rate and incidence of FLW. Increased temperatures or more variable patterns of rainfall can affect losses at the production stage and result in post-harvest conditions that are more likely to result in losses in other segments of the supply chain without effective adaptation measures such as improved and resilient crop varieties or enhanced storage facilities. Changes in climate can also result in increased incidence of pests and diseases resulting in additional losses.

At the global level, the major contributors to the carbon footprint of FLW differ by commodity group. This can be seen in Figure 10,¹⁸³ in which cereals are

the largest contributor to the carbon footprint of FLW at 34 percent of the total, followed by meat at 21 percent and vegetables at 21 percent.¹⁸⁴ Meat from livestock accounts for only 15 percent of FLW by volume, but almost 33 percent of the sector's total carbon footprint because food products with higher embedded emissions result in higher carbon footprints when lost or wasted. The highest impact of FLW is at the consumer level, where all value chain operations have already been finalized.

Asia dominates the world's vegetable production and consumption, with more than 50 percent of both. Fruits and vegetables FLW in industrialized Asia and South and Southeast Asia has a high carbon footprint due to lost or wasted volumes occurring during agricultural production, post-harvest handling and storage, and consumption. In industrialized Asia, vegetable FLW is estimated at 11 percent, equivalent to 118 kg per capita.

FIGURE 10:
Contribution of each commodity's food loss and waste to the carbon footprint at the global level



SOURCE: FAO, 2014.

Because of the greenhouse-gas-intensive nature of rice, Asia’s main cereal crop, the carbon footprint of cereals in the region is higher than elsewhere around the world. Rice paddy production is a significant source of methane, a powerful greenhouse gas. As a result, the average carbon impact factors for rice in industrial Asia and South and Southeast Asia are 5 and 3.4 kg CO₂ eq/kg, respectively, which are considerably lower than the carbon impact factor for wheat in Europe at around 2 kg CO₂ eq/kg.¹⁸⁵



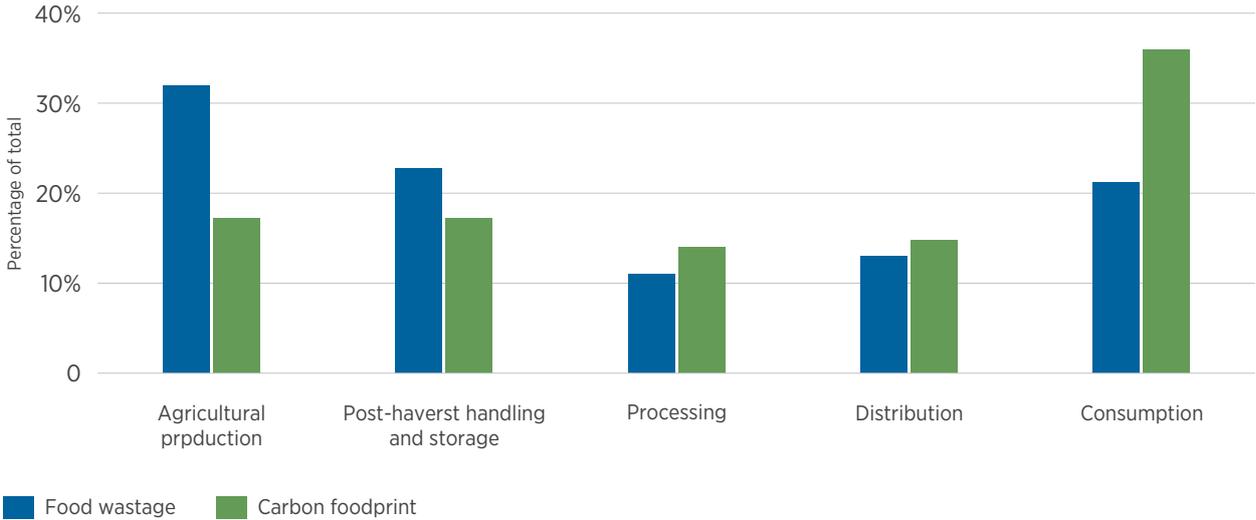
© shutterstock/ChameleonSEye

In Asia, rice dominates cereals FLW, with 53 percent in industrial Asia^{xxvii} and 72 percent in South and Southeast Asia. About 70 percent of GHG emissions from rice FLW in industrial Asia and South and Southeast Asia come during the production phase, given the high GHG-intensity of rice production methods, combined with high quantities of losses along the supply chain. Post-harvest rice losses across all Asian countries have been estimated at 15 to 37 percent,¹⁸⁶ and when combined with the loss of quality, represent a potential loss in value between 25 and 50 percent at the market level.

of low-income countries because of wasteful food distribution and consumption patterns.¹⁸⁷ In general, the carbon footprint of FLW is highest during the consumption phase at 37 percent of total, whereas consumption only accounts for 22 percent of total FLW. This is because the later that food is lost or wasted along the supply chain, the higher the environmental cost, as impacts arising during processing, transport or cooking will be added to the initial production impact. For instance, a single tomato spoiled at the harvesting stage will have a lower carbon footprint than tomato sauce wasted at the retail store.

At the global level, the carbon footprint of FLW in high-income countries is more than double that

FIGURE 11:
Contribution of each phase of the food supply chain to carbon footprint, and food loss and waste



SOURCE: FAO, 2014.

^{xxvii} China, Japan and Republic of Korea.

3.3. FLW and landfill disposal

Landfills have enormous environmental footprints and are one of the main sources of GHG emissions. Organic waste, including food waste, represents a significant share of the municipal solid waste (MSW) that finds its way to landfills around Asia and the Pacific. In ASEAN, on average 56.5 percent of the MSW, excluding Singapore,^{xxviii} is organic waste. In South Asia, organic waste is also a significant component of MSW. In Sri Lanka, Bangladesh and India, organic waste accounts for 80 percent, 65 percent and 40 percent of total MSW, respectively.¹⁸⁸ In China, 62 percent of MSW is organic waste.

Methane production increases with higher organic and moisture content at disposal sites. Gases escaping from MSW landfills not only contain toxic pollutants but are also the largest global source of human-created methane emissions. These are 25 to 72 times more potent than carbon dioxide. Landfilling should be considered only as a last resort, as it has multiple environmental, social and economic negative impacts. However, it remains the primary food waste disposal method internationally and regionally. Another challenge is the lack of physical space to allocate to landfills across Asia and the Pacific.

At the national level, the Republic of Korea has a gradual approach to minimizing food waste. In 1994, it launched its initial policy interventions

for estimation and plan reduction. In 1995, it banned landfilling of food waste from urban areas. In 1996, the country issued the “Food Waste Reduction Master Plan,” and in 1997, it launched food waste separate collections that are included in the “Comprehensive Measures for Food Waste Reduction” plan. The plan contains a volume-based food waste system that requires households to pay based on their volume of food waste.



3.4. Water impacts of FLW

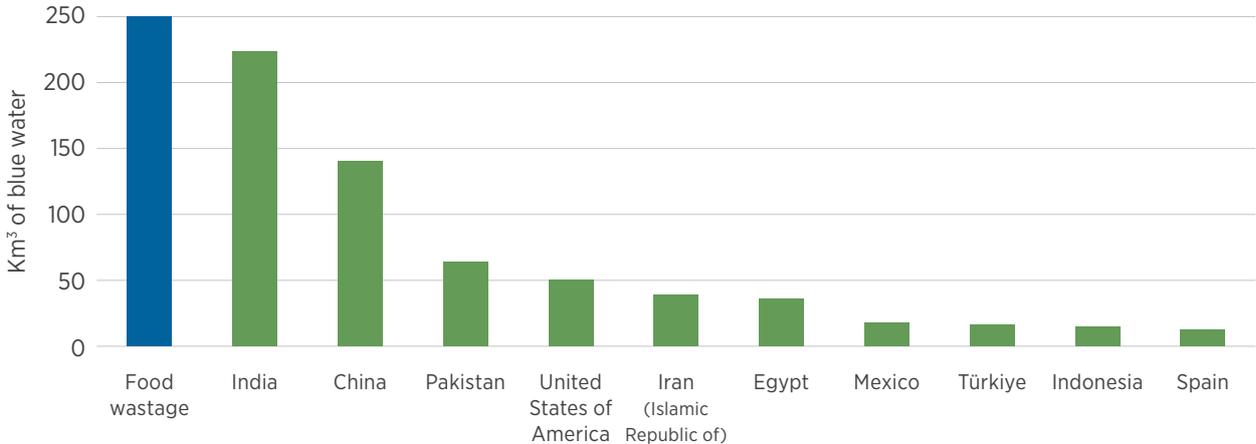
FLW implies blue, grey and green water utilization that could have otherwise been consumed or employed elsewhere. The blue water footprint is the consumption of surface and groundwater resources. FAO uses the blue water footprint to assess the impact of FLW from a water resources perspective. Blue water in agriculture is the use of irrigation water taken from ground or surface water sources.

Agriculture is the largest employer of irrigation in the form of blue water. It is an essential input

for many of the intensive agricultural production systems across Asia. When improperly managed, blue water use in irrigated agriculture has the potential to lead to environmental problems, such as water depletion, salinization, waterlogging or soil degradation. In some parts of the region growing water scarcity and land degradation resulting from poor water management are key risks to the sustainability of food production systems. As a result, water being lost or wasted due to it being embedded in FLW is a significant problem.

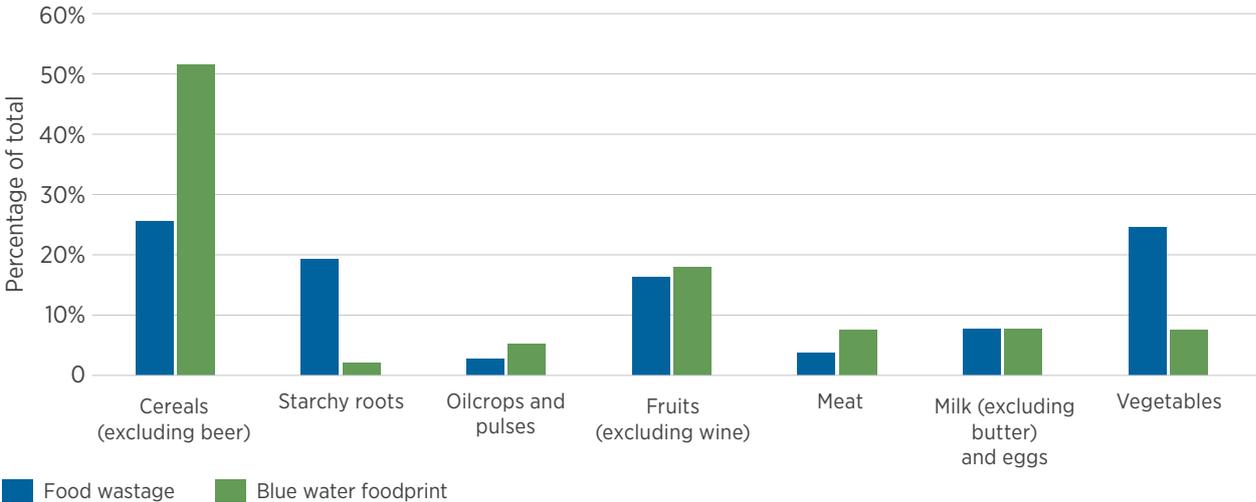
^{xxviii} In Singapore, 10.5% of the MSW is organic waste.

FIGURE 12:
Global food loss and waste compared to the blue water footprint for consumption of agricultural products of the top 10 countries



SOURCE: FAO, 2014.

FIGURE 13:
Contribution of each commodity to FLW and its blue water footprint



SOURCE: FAO, 2014.

Globally, the blue water footprint of FLW is roughly 250 km³, which is equivalent to more than half of the annual water discharge of the Mekong River (453 km³). If FLW were a country, it would rank first in the world for water footprint due to consumption for food production. The water footprint of FLW in Asia is larger than in any other region in the world because of its wide use for irrigation in the production of cereals, including rice and wheat.

The major contributors to the global blue water footprint of FLW are cereals, at 52 percent of the total, and fruits at 18 percent, whereas their contributions to total food wastage are 26 percent

and 16 percent, respectively. By contrast, starchy roots account for 2 percent of the water footprint, while this commodity represents 19 percent of total FLW. For instance, Le Roux *et al.*¹⁸⁹ estimated FLW along farm-to-consumer supply chains to gauge the water footprint of vegetables produced on the Steenkoppies Aquifer in Gauteng, South Africa. They estimated lettuce at 38 percent, cabbage at 14 percent, and broccoli at 13 percent, with 70 percent of loss occurring on-farm at the packinghouse. “It was estimated that blue water lost on the Steenkoppies Aquifer due to vegetable FLW (4 Mm³ year⁻¹) represented 25 percent of the estimated blue water volume that exceeded sustainable limits (17 Mm³ year⁻¹).”

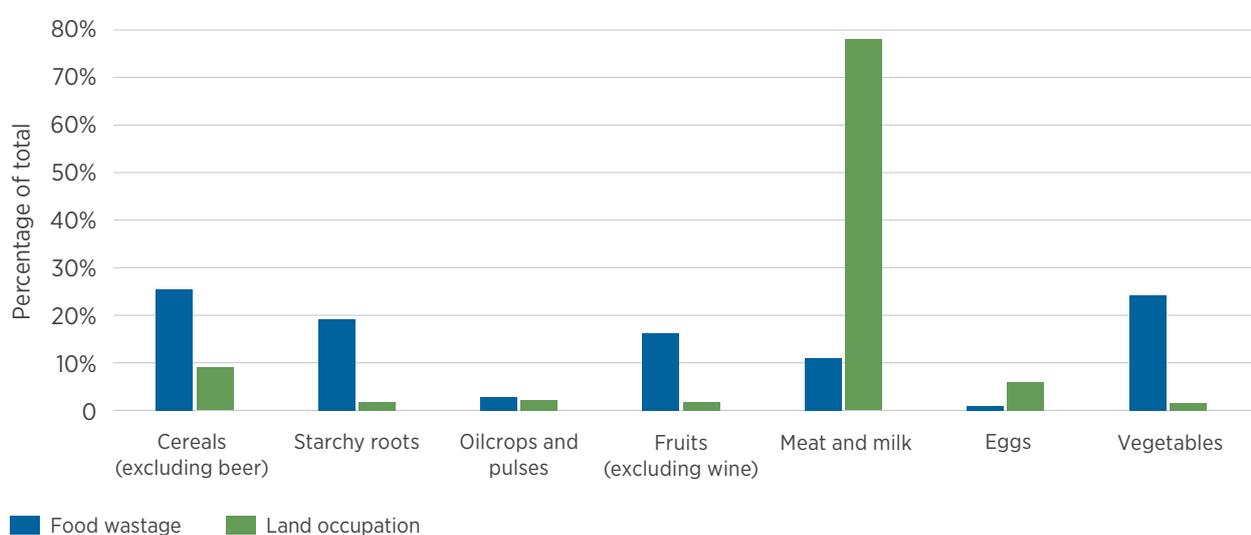
3.5. Land use and biodiversity impacts of FLW

FLW involves the use of land that could have otherwise produced food to be consumed or employed for other ecosystem services. To assess land use embedded in FLW, FAO uses the metric of land occupation, which describes the surface of land, including cropland and grassland, necessary to produce food.

Globally, food produced but not eaten occupies almost 1.4 billion hectares of land, close to

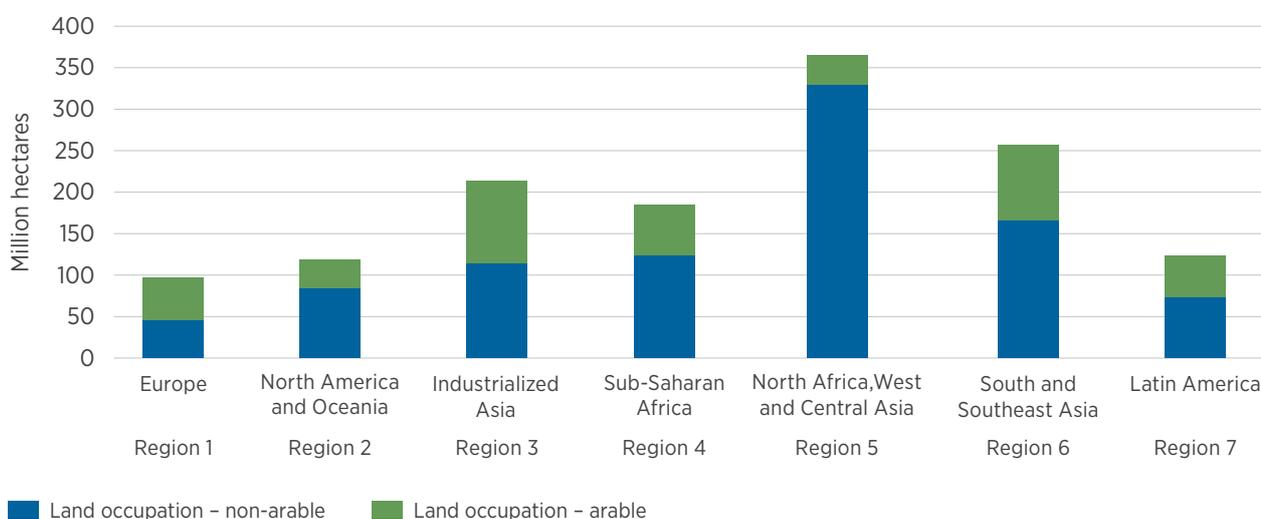
30 percent of the world’s agricultural land area. Land used for meat and milk production account for the highest percentage of land where FLW takes place, at 78 percent, despite the fact that they account for just 11 percent of total food wastage overall. This is because of the large share of non-arable land occupied for meat and milk production as pastures and meadows, as well as the arable land indirectly wasted as feed crops for wasted meat and milk products.

FIGURE 14:
Contribution of each commodity to FLW and land occupation



SOURCE: FAO, 2014.

FIGURE 15:
Land occupation of FLW by region



SOURCE: FAO, 2014.

At the regional level, Asia, when combining industrialized Asia with the countries of South and Southeast Asia, has the most land where FLW is taking place compared to other regions. Regional land competition is unnecessarily increased by FLW.

The analysis of land-related impacts due to FLW does not account for land degradation associated with agricultural production or potential impacts on biodiversity. However, while deforestation to make way for agricultural production is still a significant problem in Southeast Asia, the impacts

of this deforestation are not fully accounted for in the assessment above.

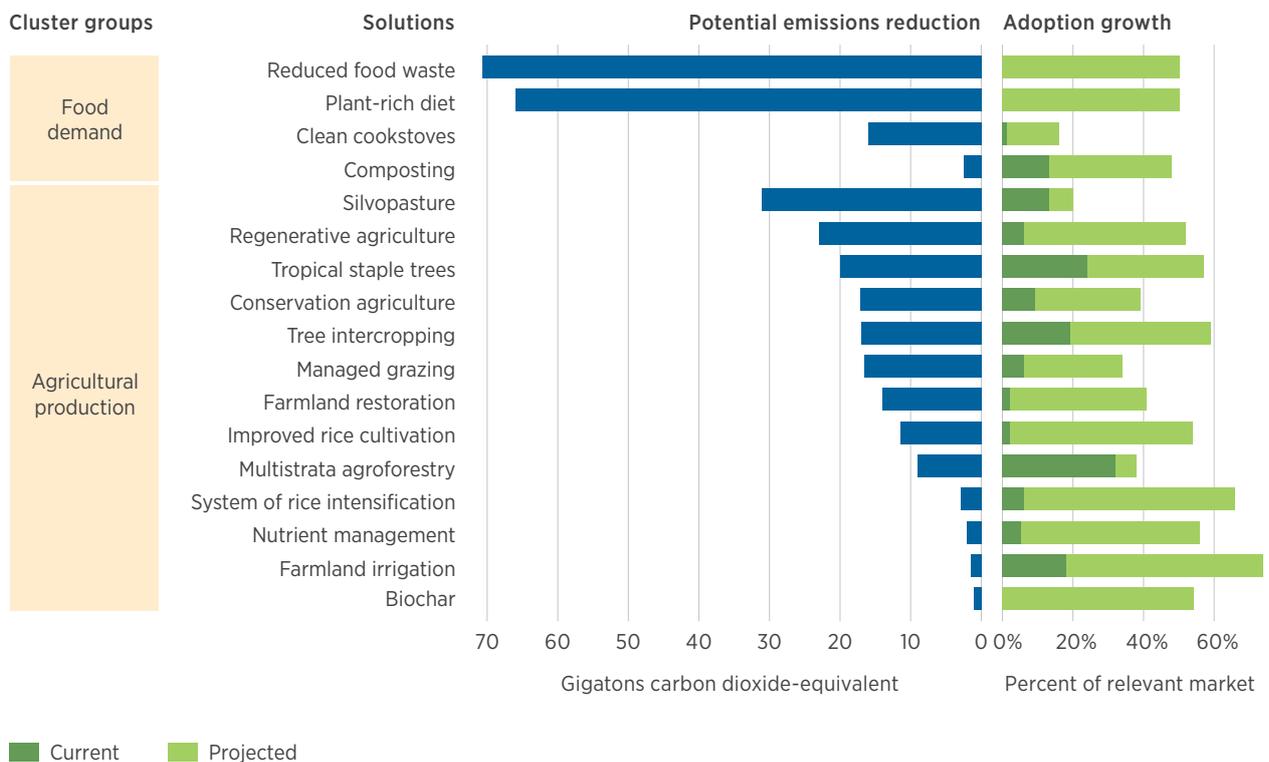
FLW forces the adoption of more intensive practices to make up for shortfalls resulting from inefficiencies in the supply chain that can cause further degradation. Food production, whether through intensification or expansion, can be a major threat to biodiversity if it does not adopt a food system approach for nutrition. Developing countries are also at major risk from concurrent climate change pressures.

3.6. Addressing the impact of FLW on the environment

Reducing and preventing FLW is key to reducing environmental impacts along food supply chains. At the global level, reducing FLW has been identified as the most effective option for reducing emissions from the food sector, potentially resulting in emissions reductions of over 70 gigatonnes of CO₂-eq.¹⁹⁰ Coordination by state and non-state actors is required to achieve impact at scale through FLW reduction.

Incorporating FLW into countries nationally determined contributions (NDCs) under the Paris Agreement (SDG 13) could open up opportunities to attract climate finance to activities and measures aiming to prevent and reduce FLW. An integrated approach would result in these measures being adopted both in support of SDG 12 and as contributions to other SDGs, as well as the NDCs that outline targets, measures and priority actions for climate change mitigation and adaptation.

FIGURE 16:
Food sector plausible scenario emissions and adoption results, 2020 to 2050



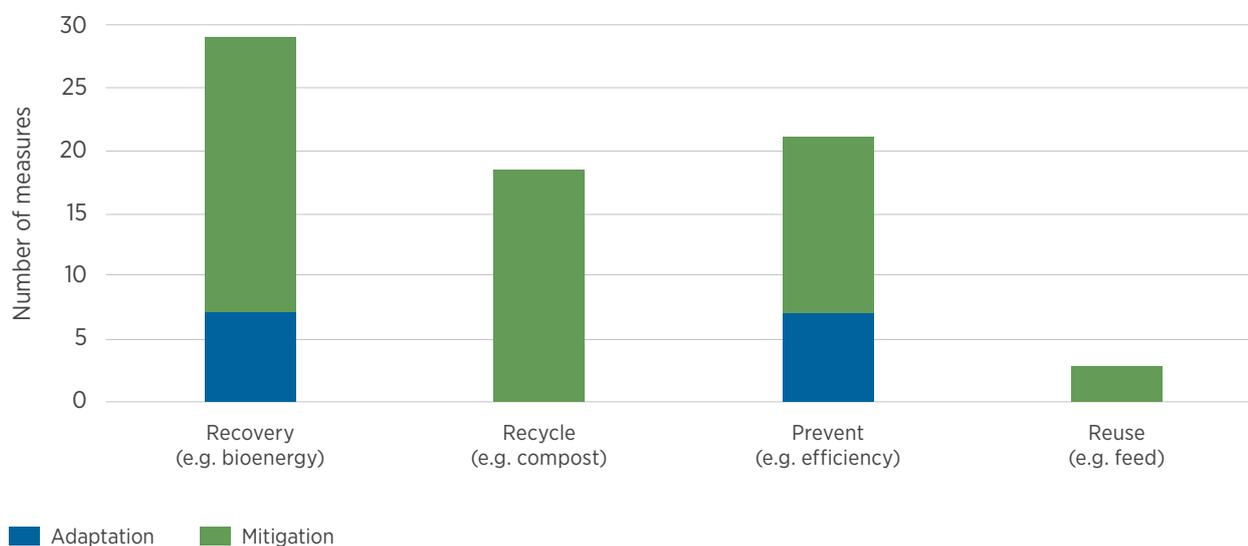
Around 90 percent¹⁹¹ of countries in Asia and the Pacific promote FLW reduction-related measures in their NDCs. Measures that target FLW reduction cover a range of actions including recovering biomass through bioenergy, recycling biomass through the use of waste for organic fertilizer, preventing biomass losses in general through better storage or post-harvest operations, and reusing biomass through the use of crop residues for feed.

Preventing FLW is an effective climate change mitigation strategy. Understanding the technical and economic feasibility of other technologies and measures that involve utilization of food-derived waste or losses is also important for informing future thinking about NDCs. It is not feasible to have zero FLW, and adoption of such technologies may also generate demand for FLW. These types of trade-offs should be considered in developing priorities for secondary measures that target improved efficiency through utilization of FLW.

Among the adaptation measures in the NDCs associated with the greatest number of potential mitigation co-benefits are agroforestry, followed by crop management, and food loss reduction. The Koronivia Joint Work Agenda presents an opportunity for countries to highlight sectoral needs and priorities, particularly reducing food loss.

Table 6 lists some of the measures related to reducing or preventing FLW. These measures could be incorporated as priorities under NDCs, following the food-use-not-loss-or-waste hierarchy approach.¹⁹² They could be considered when analysing data and deciding priorities for FLW prevention and reduction interventions and investments. In setting priorities and deciding upon measures, countries should consult the five pillars of this Strategy.

FIGURE 17:
Food loss and waste reduction-related policies and measures, by type, in the nationally determined contributions of countries in Asia



SOURCE: NDCs.

**TABLE 6:
Potential mitigation or adaptation measures to reduce or prevent FLW that could be incorporated as priorities under nationally determined contributions**

Technical focus	Potential measures
Mitigation	<ul style="list-style-type: none"> • Raise awareness on FLW • Develop and implement national policy frameworks and strategies to reduce harvest and post-harvest losses • Implement legislation to lower food waste • Improve communication along the supply chain to match demand and supply of food – optimize demand and supply • Improve harvest, storage, processing and packaging, cooling and refrigeration, transportation and retailing processes • Improve quantity planning for food services (HORECA sector) – demand forecasting • Improve consumption habits through enhanced food literacy among consumers of all ages • Develop markets for food products outgraded by retailer supply chains • Recovery and redistribution of safe and nutritious food – from production to food services – for food-insecure people • Explore extraction of bio-active compounds from processing operations, without going into competition with the above options • Explore the potential of animal feed from food that is at risk to be wasted (the former foodstuffs category), without going into competition with the above options • Compost what cannot be considered in the abovementioned bullet points, without going into competition with the above options • Explore technology and resources needed for generating electricity from agricultural loss and waste along the supply chains, without going into competition with the above options
Adaptation	<ul style="list-style-type: none"> • Enable access to quality seeds, including drought/water-logged resistant seeds • Enable on-time harvest-planning demand forecasting • Implement environment-friendly pest and disease management • Establish early warning systems • Strengthen Good Agricultural Practices (GAP), Good Manufacturing Practices (GMP), Good Hygienic Practices and Hazard Analysis, Critical Control Point system (HACCP), and Global GAP • Explore technology and resources needed for generating electricity from agricultural loss and waste along the supply chains, without going into competition with the above options

An important area for intervention concerning climate change mitigation is the introduction of cooling and freezing technologies to preserve fish (relevant to SDG 14) and make ice, ensuring that these technologies work with solar power in remote areas. As an example, in the Solomon Islands, WorldFish and the West Are'are Rokotaniken Association have introduced solar-powered freezers, which are smaller and less expensive, as an alternative to the centralized cold storage provided by fisheries centres.¹⁹³

The United States Agency for International Development (USAID) and the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) have launched research to focus on building the evidence base for potential of climate change mitigation¹⁹⁴ from prevention and reduction of FLW. The research contains preliminary advance estimates of the impacts of

interventions across 20 value chains in 12 countries, with actions from production to the consumer level, with the dairy sector being one of the most significant in both FLW and mitigation potential.

A bottom-up shift towards food waste prevention can also be incentivized if decision-makers and consumers are supported by better data on quantities and types of food waste generated by source. Countries can achieve this step by step, for instance, implementing food waste segregation and separate collection. On the other hand, the food-use approach prioritizes prevention at the source, recovery, and redistribution of safe and nutritious food for direct human consumption, and extraction of bio-active compounds, followed by feed from former foodstuff. Both approaches, an organic waste minimization approach as well as a food-use-not-waste approach, can be considered in Asia and the Pacific countries.

BOX 21: Singapore: Food waste – segregate, recycle, and reduce disposal and haulage fees

From 2024, Singapore requires the following establishments to segregate food waste for treatment:

- i. Shopping malls with a food and beverage area of more than 3 000 m²;
- ii. Hotels with food, beverage and function area of more than 3 000 m²;
- iii. Large food manufacturing businesses operating in an area of more than 750 m²;
- iv. Multiuser factories with at least one large food manufacturing business (operating in an area of more than 750 m² in a factory);
- v. Multiuser factories with more than 20 000 m² of gross floor area and more than 20 food tenants such as food manufacturers and caterers.

The National Environment Agency (NEA) will update the Code of Practice on Environmental Health given the abovementioned measures. It has a 3R Fund that supported 25 premises to install on-site food waste treatment systems that generate cost savings from reduced waste disposal and haulage fees. Currently, data from the NEA state that only 18 percent of food waste is recycled.

SOURCE: <https://www.nea.gov.sg/media/news/news/index/businesses-required-to-segregate-food-waste-for-treatment-under-new-legislation#:~:text=Singapore%2C%20March%202020%20%E2%80%93%20From,%2Dsite%20or%20off%2Dsite>



In November 2020, the annual Asia-Pacific Agri-Food Innovation Summit was held virtually. Its theme was Innovation in Supply Chain Resilience, Urban Food Systems, Alternative Proteins and Affordable Nutrition. FLW minimization and opportunities to upcycle were discussed along with what contributions many of the regions' companies are already implementing or considering to invest in. Among the participants was GreenPod Labs, an agribiotech company that is developing solutions to minimize agricultural losses in India. These include a nanotechnology-based active packaging that can extend the shelf life of fruits and vegetables by using plant phenolic compounds that slow down ethylene biosynthesis. Technological solutions, backed by behaviour change of actors along supply chains, can support both FLW reduction and lower GHG emissions from the food system through an increase in productivity and lowering (bio-)waste to landfills.

Education plays an important role in fostering

social and technological innovations for FLW prevention and reduction. Opportunities for investment are being developed in the Asia and Pacific region. Students from the National Taipei University of Technology have developed a labelling system that won the 2020 James Dyson Award.¹⁹⁵ Their technological solution is called Barcodiscount, and it can prevent food from becoming waste while increasing retailers' revenues. It applies a colour-changing technology to stickers that display different colours and discounts based on how close the product is to its expiration date. For instance, the label displays 20 percent off at 48 hours until expiring, which then it changes to 40 percent when it reaches 24 hours.

Launching social and technological innovations through public-private nudging approaches can facilitate uptake by both companies and consumers, contributing not only to reducing the impact of food waste on the environment, but also reducing the linked packaging waste impacts.





REGIONAL STRATEGY ON FOOD LOSS AND WASTE REDUCTION FOR ASIA AND THE PACIFIC



4.1. Vision, goal and strategic objective

The *FAO Regional Strategy on Food Loss and Waste Reduction in Asia and the Pacific* has been informed by a detailed literature review, past and ongoing FAO activities at the national, regional and global levels, and country studies.^{xxix}

In 2018, FAO Member Nations in Asia and the Pacific expressed interest and requested guidance on food loss and waste (FLW) at the FAO Regional Conference in Fiji, and the 2020 FAO virtual Regional Conference highlighted that “improving data collection on FLW is a priority for monitoring progress towards achieving the SDGs.”¹⁹⁶

^{xxix} Regions: Africa, Europe and Central Asia, Latin America and the Caribbean, Near East and North Africa. Countries: China, Nepal, and Thailand.

Vision: Contribute to improved food security, nutrition and climate change mitigation in the Asia and the Pacific Member Nations through reduced food loss and waste along food supply chains and at the household level.

Goal: “By 2030, halve per capita global food waste at the retail and consumer levels, and reduce food losses along production and supply chains,

including post-harvest losses” (SDG target 12.3).

Strategy objective: To effectively support Asia and the Pacific state and non-state actors in preventing and reducing food loss and waste by 2030.

The Strategy introduces the Five Pillars that are mutually reinforcing and provide a systemic approach to supporting FLW prevention and reduction.

4.2. The Five Pillars

The Strategy is supported by an Action Plan that highlights the purpose, timescale, and actions for delivering on the Five Pillars.

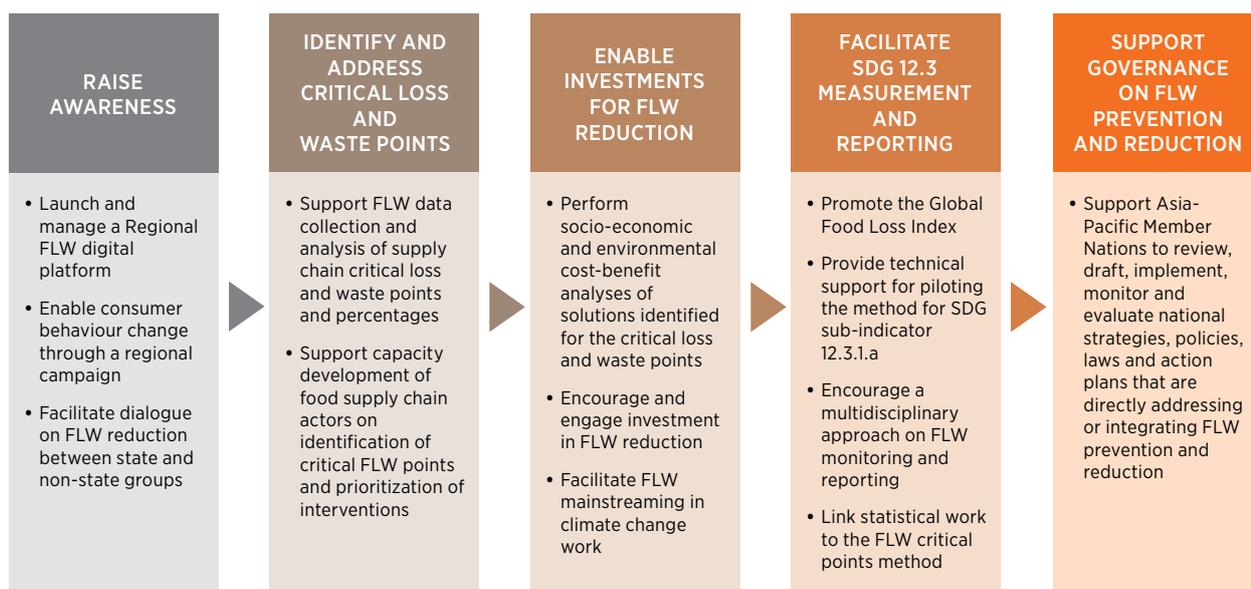
4.2.1. Pillar 1: Raise awareness and enable state and non-state collaborations and partnerships on FLW prevention and reduction

Pillar 1 is focused on raising awareness on the levels, types, impacts and solutions for food losses from production to wholesale; food waste from retail to households; and enabling state and non-state

collaborations and partnerships towards food losses and food waste prevention and reduction.

Intervention areas cover the launch and management of a regional awareness campaign through a FLW knowledge platform that facilitates the shift towards changed behaviour of supply chain actors and consumers. They address multi-actor consultations on FLW data sharing on levels, types, impacts and solutions. And they deal with knowledge transfer on FLW prevention and reduction through regional, national, and local face-to-face and virtual events that include capacity development on methodological tools from FAO and other parties.

FIGURE 18:
The Five Pillars of the FAO Regional Strategy on FLW Reduction in Asia and the Pacific



Actions could include:

1. Raise awareness and develop capacity for the National Food Loss Index and the Global Food Loss Index as the means for national monitoring and reporting progress by countries on SDG target 12.3.1.
 2. Raise awareness and develop capacity on the FAO critical loss points case study method through the e-learning courses on food losses and on fish losses, along with other methodological tools. These are a means for governments and non-state actors to improve the evidence base and track progress for SDG 12.3.1.a.
 3. Facilitate and enhance state and non-state collaborations and partnerships:
 - Raise awareness on the opportunity to collaborate between FAO Member Nations in Asia and the Pacific for FLW reduction in the context of sustainable and resilient food systems.
 - Operationalize a comprehensive action oriented Regional FLW Platform in support of SDG target 12.3, integrating Pillars 2, 3, 4, and 5 knowledge and results. The platform will coordinate with the global FAO and partners Technical Platform on the Measurement and Reduction of Food Loss and Waste and engage regional partners and stakeholders.
 - Publish a policy brief on FLW commitments within the nationally determined contributions (NDCs) in the region.
 - Enhance awareness on nutritional impacts of FLW.
- Develop a framework to support Member Nations to recover and redistribute surplus food for direct human consumption.
 - Engage with international financial institutions, and other partners along supply chains and at the consumer level. These include UNEP, academia and the private sector. Work with them on SDG target 12.3.1 methodology, and cost-benefit and feasibility analyses for prioritization of interventions for FLW reduction. This includes contributions to relevant international, regional and national meetings of the International Cold Chain Alliance to provide evidence of cold chains' role in reducing food losses, particularly for perishables such as fruit and vegetables, in view of their importance for nutrition and sustainable food systems.
 - Actively engage consumers in food waste prevention and reduction through coordinated messaging and collaborations with health and consumers-oriented organizations such as the World Health Organization – Regional One Health, and Consumers International. For example, the FAO/International Food Waste Coalition educational materials on food waste for schools can support Pillars 2 and 3 of the FLW Strategy (improving data and enabling reduction) through partnerships among schools, the private sector and civil society in both urban and rural areas.
 - Inform climate finance actors on the opportunity represented by FLW prevention for GHG emissions reductions, and climate change mitigation and adaptation through enhanced dialogue with climate change initiatives and work groups for NDCs under the Paris Agreement.
 - Support improved knowledge and awareness on the need for and role of increased investment in FLW prevention and reduction through seminars focused on the role of investment institutions, regional banks and development partners.
 - Organize regional and national level events (virtual and face-to-face) with state and non- state partners and collaborators dedicated to innovative socio-economic and technological solutions to FLW.



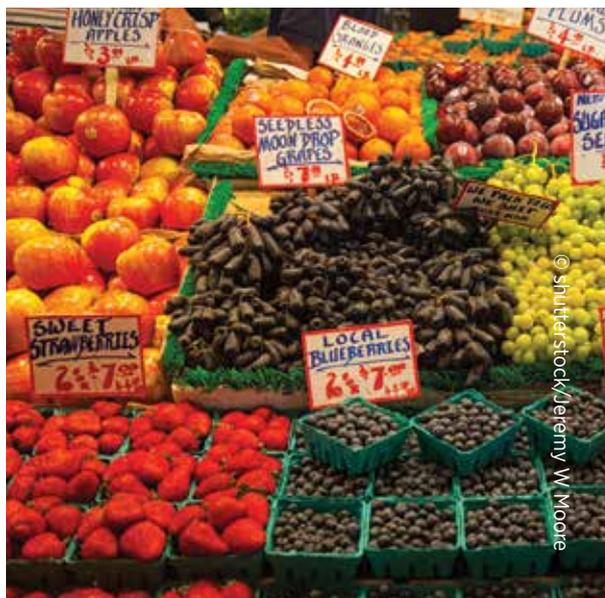
4.2.2. Pillar 2: Identify and address food loss and waste at critical points along supply chains and at the consumer level

Pillar 2 is focused on capacity development of food supply chain actors to identify critical FLW points and approaches to prioritizing interventions. An increase in Asia and the Pacific FLW data availability and quality at the national level and food supply chain level, including households, would support SDG indicators 12.3.1.a and b. Pillar 2 also focuses on effective linkage of the FAO critical loss points (CLPs) methodology, and other relevant data, with improved collection and validation of statistically relevant data and information on FLW at the national level through collaboration with relevant national statistical authorities.

Intervention areas cover (i) identification of food loss percentages¹⁹⁷ and root causes through the FAO CLP case study method (Annex 2) that has been recommended FAO's The State of Food and Agriculture¹⁹⁸ as an effective data collection approach; (ii) dissemination of the FAO e-learning course on the CLP method, applicable for all food supply chains, is available in parallel with an e-learning course focused on the fisheries sector. The FAO CLP case study methodology covers harvest up to wholesale and retail, including the possibility of identifying food waste critical points and root causes; (iii) consultation with stakeholders and publication of technical briefs on methods for food loss and for food waste, and results obtained for data collection and analysis by state and non-state actors.

Actions could include:

1. Launch multi-stakeholder consultations hosted by the Regional FLW Platform to facilitate knowledge sharing on FLW data quality, availability, national and local priorities;
2. Contribute to the regional and national evidence on FLW causes, quantities, and consequences (social, environmental, and economic) through the implementation of the CLP and other methods, as prioritized and indicated by national and local state actors;
3. Support Member Nations to identify and address critical loss points in their prioritized food supply chains and how to develop and feed data into the SDG target 12.3 indicators;
4. Develop knowledge and provide information on technological and socio-economic options for FLW reduction, possibly in collaboration with other organizations/regional partners;
5. Share approaches for the identification of direct and indirect causes of FLW and related investments;
6. Promote and facilitate knowledge exchange on recovery and redistribution of safe and nutritious food for direct human consumption through knowledge sharing on the Regional FLW Platform, such as consultations on food banking. Partnering with regional and international foodbanking networks, and national initiatives to foster and stimulate uptake and expansion of improved reuse and redistribution of food will be a useful means to support achieving the goal of this strategy;
7. Support and encourage the inclusion of FLW prevention and reduction in food systems and value chain programmes and projects in support of intervention coherence and multi-target achievements, such as environmental, social economic, food security and governance.



© Shutterstock/Jeremy W Moore

4.2.3. Pillar 3: Enable investments for FLW prevention and reduction

Pillar 3 is focused on investments in FLW prevention and reduction that could be made based on national, local, and food business operator objectives.

Intervention areas cover effective engagement with state and non-state actors to assess trade-offs, such as cost-benefit analysis outcomes, based on evidence that can guide the investment decisions. Consultations focused on FLW prevention and reduction should be conducted with international financial institutions such as IFAD, the Asian Development Bank, the World Bank and Rabobank.

Actions could include:

1. Develop an enhanced approach for FLW impact measurement and reduction in support of climate change objectives, and impact reduction;
2. Support and advise on FLW technologies and investments for preventing and reducing food loss and waste;
3. Support Member Nations in examining trade-offs in FLW reduction for economic, social and environmental objectives;
4. Promote and facilitate enhanced market access, storage, logistics, infrastructure and processing facilities within investment programmes and projects for effectively reducing food loss. This can range from improved provision of
5. Mainstream FLW into projects targeting improved environmental benefits through funding mechanisms such as the Green Climate Fund and the Global Environment Facility in Asia and the Pacific, and develop supporting tools for reducing FLW as part of the food system transformation and land-use restoration approach;
6. Engage with regional and global private sector initiatives to foster collaboration between companies for FLW data improvement and solutions implementation;
7. Expand the evidence base on business cases for commodity-specific and sector-specific FLW interventions. Convene regional consultations for state and non-state actors to explore and document FLW lessons learned and successes in the region;
8. Proactively engage with regional IFI and development/agriculture banks for sensitizing on the need for investments in FLW reduction and support for large-scale investments as done by FAO for AfDB on post-harvest management (value USD 1.5 billion), and the World Bank under the Food Loss and Waste Bond;
9. Explore innovative partnerships with the private sector, such as the Rabobank Foundation under their Innovation Challenge, to enable social and technological disruptions towards FLW prevention and reduction.

infrastructure to technologies for improved harvesting, crop storage, improved processing and preservation technologies and processes, and enhanced market access;



4.2.4. Pillar 4: Monitor and facilitate national and regional progress towards SDG target 12.3

Pillar 4 is focused on SDG target 12.3 and the indicator 12.3.1.a, the National Food Loss Index and the Global Food Loss Index that have been developed by the Statistics Division of FAO. The methodology can measure and model country food losses using the food balance sheets, though the availability of country-level statistics on food losses varies greatly among regions, and, in general, such data are far from sufficient.

Intervention areas cover one of the challenges in the measurement of FLW and the rollout of the National Food Loss Index is the complexity of a clear and shared understanding of the data needs, how to prioritize commodities, and which combination of data collection, direct measurement methodologies and modelling countries can or should undertake to effectively generate good-quality estimates of food loss and waste. The importance of understanding a commodity's supply chain and critical loss points is essential in efficient data collection and estimation to compile the index.

The FAO Regional Office for Asia and the Pacific is actively engaged with and supporting Member Nations in SDG 12.3.1.a measurements and monitoring, including through its Technical Cooperation Programme, the Global Strategy for Improvement of Rural and Agriculture Statistics, and the Guidelines on the Measurement of Harvest and Post-harvest Losses (on post-harvest losses of grains and cereals with guidance on other food groups under development), among others.

Actions could include:

1. Support rollout of the Global Food Loss Index and the National Food Loss Index in Asia and the Pacific through targeted training, technical assistance and pilot testing data collection/estimation approaches. Collaboration with Pillars 2 and 3 is essential for identifying needs and providing timely specialized technical support and advice;
2. Support and build the capacity of national governments in improved monitoring and reporting on SDG indicator 12.3.a, focused on the Food Loss Index;
3. Improve the measurement of climate change impacts from FLW in Asia and the Pacific to inform NDC target revisions and monitoring systems, as well as investment for FLW reduction;
4. Promote and facilitate the use and uptake of the FAO CLP case study methodology for collecting primary data on the causes and required investments to reduce food losses in developing countries. It is one of the key methodologies to develop and validate food loss and waste data, and is one of the only methodologies to go beyond assessments and identify underlying causes of losses, what can be done and what is needed, including cost-benefit analyses and investments. The inclusion of nutrition losses into quantitative loss measurements would be very useful to better target interventions on nutrition. Compilation of SDG indicator 12.3.1.a also benefits significantly from synergies with this methodology;
5. Provide targeted and specialized technical support for countries on how to adopt, apply and tailor the statistical methodology for national data collection and analysis to provide statistically representative data on a selected range of seven or eight key commodities. Timely provision of combined statistical, analytical, and food system support is key, including dissemination of this data to the private sector supply chain actors who also benefit from reduced FLW;
6. Contribute to and engage on FAO corporate capacity development materials on SDG 12.3.1 and 2. Investment is needed in Asia and the Pacific to update and improve data to support successful FLW prevention and reduction approaches.



4.2.5. Pillar 5: Support Asia and the Pacific Member Nations to develop and implement coherent governance frameworks for addressing FLW prevention and reduction

Pillar 5 is focused on institutional capacity development to drive behavioural change towards FLW prevention and reduction; and advising state actors on the economic, social, and environmental costs of producing food and the benefits that can be achieved from FLW prevention and reduction, including climate change mitigation and adaptation measures.

Intervention areas cover technical and governance consultations and publications on evidence-based linkages between FLW prevention and reduction, and country level-commitments on climate change, improved food security and sustainable food systems. These could create opportunities for embedding clearly identified FLW prevention and reduction targets, strategies and programmes into national or local plans. They could also guide both domestic and external investors. Interventions also cover supporting Asia and the Pacific Member Nations to review, draft, implement, monitor and evaluate, national strategies, policies, laws and action plans that are directly addressing or integrating FLW prevention and reduction.



Actions could include:

1. Enhance knowledge sharing on governance for FLW reduction and prevention through the FLW Regional Platform;
2. Support Member Nations in enhancing multi-sector engagements and governance on SDG target 12.3;
3. Provide technical support for the review, design and implementation of strategies, policies, laws and action plans on reducing FLW at the regional and national levels based on the evidence generated and enriched under the other four pillars of the *FAO Regional Strategy on Food Loss and Waste Reduction in Asia and the Pacific*. This should also support the review and decision processes of government and non-state actors in assessing priorities in terms of multiple policy objectives. The objectives may include economic development, investment support to small-scale food production for income generation, improved nutrition and food security, and climate change mitigation and adaptation;
4. Develop institutional capacity and collaborate on SDG indicator 12.3.1.a. The indicator implements a novel approach and measurement method that requires cross-ministerial and multi-stakeholder mechanisms. Collaboration should be fostered between regional bodies such as ASEAN and SAARC, and participation in regional and international events related to FLW to not only improve awareness but also promote multi-sector and institutional collaboration. This includes, for example, the need for enhanced collaboration between ministries involved in agriculture and food with respective statistical and health/consumer authorities, and to recognize that data on loss percentages at critical loss points, by commodity, can serve as an important advocacy tool to motivate private sector solutions;
5. Provide multidisciplinary policy briefs, reports and capacity development, based on outputs from the other four pillars of the *FAO Regional Strategy on Food Loss and Waste Reduction in Asia and the Pacific*. This would be for regional and inter-regional knowledge transfer and collaborations to facilitate socio-economic and technological innovations, and scaling-up solutions in rural and urban areas, from production up to households.



CONCLUSIONS AND WAY FORWARD



FLW is a significant concern for Asia and the Pacific. In 2019, FAO estimated food losses ranging from 5 to 6 percent in Australia and New Zealand to 20 to 21 percent in Central and South Asia. Moreover, the Food Waste Index Report highlighted that in Southeast Asia only 10 countries have food waste data points from retail to households, while global estimates indicate that in 2019 approximately 931 million tonnes of food waste were generated, 61 percent of which came from households, 26 percent from food services and 13 percent from retail.¹⁹⁹

To date there have been only limited coordination and exchanges of information among Member Nations in the region on this issue. Therefore, an informed, multi-actor and multidisciplinary *FAO Regional Strategy on Food Loss and Waste Reduction in Asia and the Pacific* is needed and timely.

The Asia and Pacific region has many diverse food systems, and food losses and waste exist side

by side. They impact food availability through quantitative losses, income and returns on investment because of the loss of the economic and nutritional value of food. At the same time, overweight and obesity is on the rise for all age groups concurrent with the challenge to improve food and nutrition security for 479 million of the total world's undernourished.

Global FLW ranks as the third top GHG emitter, after the United States of America and China. Close to 30 percent of the world's agricultural land produces food that ends up either lost or wasted. FLW represent inefficiencies that worsen climate change worldwide. Opportunities linked to FLW prevention and reduction have already been identified by the nationally determined contributions (NDCs) that can support SDG 13 and the Paris Agreement. Asia and the Pacific FAO Member Nations could tap into win-win climate finance and agro-industry innovation projects addressing FLW, climate change and the environment.

Reductions in FLW are one of the main impact areas identified for minimizing carbon dioxide emissions, according to the UN Environment and Climate and Clean Air Coalition, 2021. Preventing FLW for all food groups, improving livestock management, and the adoption of healthy diets could reduce carbon dioxide emissions by 65 to 80 Mt/yr over the next few decades.²⁰⁰ Measures that are highlighted include strengthening and expanding cold chains,^{xxx} consumer education, and recovery and redistribution of safe and nutritious food for direct human consumption.

There is a high level of interest in micronutrient deficiency prevention. FLW represents a missed opportunity to reduce malnutrition and improve food security. This requires increased awareness among state and non-state actors through improved FLW knowledge on the levels, types, impact, and cost-benefit analyses on identified solutions, ideally through an improved Asia and the Pacific FLW knowledge platform linked to the global *Technical Platform on Food Loss and Waste Measurement and Reduction* of FAO and its partners.

Small food producers face challenges to apply adequate agricultural practices, access finance, markets, and ensure a balanced negotiation in contractual agreements. Food losses can be caused by any of these challenges, along with the lack of available and accessible food contact materials and packaging, energy, optimized processing and transportation, and local markets infrastructure. Actors in the supply chains, such as wholesalers, retailers and food services, could further explore socio-technological innovations, such as digitalization and artificial intelligence, for their potential and current role in quantifying, categorizing and calculating cost-benefit ratios for FLW prevention and reduction.

Many solutions for preventing and reducing FLW are available for rural and urban areas that have been tested and achieved prevention and reduction targets worldwide. Solutions exist for all points in the supply chain, including households. Asia and

the Pacific could improve access to information about available options. Solutions would increase productivity and profitability across supply chains while preventing and reducing FLW. They include post-harvest improved storage techniques that are energy efficient or use renewables, optimized processing, improved transportation, and enabling of finance and market access.

Among the available solutions that the region is currently implementing in a fragmented way are the recovery and redistribution of safe and nutritious food through gleaning networks, food banks, food pantries and social supermarkets. These solutions could be scaled up. FAO RAP could support developing action-oriented guidelines and tools for implementation, monitoring and evaluation. FAO could support implementation of solutions that use the reduce, reuse and recycle (the 3Rs) approach, in partnership with national governments, municipalities, the private sector, and civil society organizations.

Key challenges to reducing FLW include:

- Lack of awareness of the scope and scale of FLW;
- The need for quantification of phenomena such as critical loss and waste points along supply chains, and statistical reporting for SDG indicators 12.3.1.a and 12.3.1.b, the Food Loss and the Food Waste Indices;
- A lack of understanding FLW's recurring impacts on food (in-)security and nutrition, climate change and the environment, and how social and technological innovations can support private-public-civil society actions;
- The need to enable and facilitate policy and regulatory development through multi-stakeholder and multidisciplinary consultations that orient investments for the short-, medium-, and long-term reduction of FLW.

^{xxx} “includes opportunities to mitigate climate change by replacement of hydrofluorocarbons with more climate friendly substances” (UNEP and Climate and Clean Air Coalition (2021)).



Addressing these challenges is crucial for supporting Member Nations' policies and actions necessary to achieve SDG target 12.3. These will also directly impact the success of other SDGs, such as SDG 6 (sustainable water management), SDG 11 (sustainable cities and communities), SDG 13 (climate change), SDG 14 (marine resources), and SDG 15 (terrestrial ecosystems, forestry, biodiversity).

FLW data quality and availability should be significantly improved to support decision-makers for investments in rural infrastructure that can contribute to reduced post-harvest loss and improve marketing margins.²⁰¹ FAO RAP could support this process as part of its technical assistance programmes. While some countries in the region have already started to act on FLW reduction, more significant attention is required to reach SDG target 12.3 by 2030 in view of its contribution to achieving SDG 1 (no poverty) and SDG 2 (zero hunger).

Major improvements in FLW data could provide evidence for scaling up interventions for prevention and reduction, and incentivize the achievement of SDG target 12.3.²⁰² Statistical methods developed by FAO to monitor and report FLW need to be tailored through providing support to governments in the region for data collection methodologies and multidisciplinary efforts among stakeholders in agriculture, environment and health.

Educating consumers of all ages is essential to

effect change. The 2018 FAO teaching toolkits on food waste prevention and reduction for children and young students can be translated and localized for Asia and the Pacific, in partnership with national organizations and government agencies. Consultations on opportunities for implementation in formal and informal settings in both rural and urban contexts can be explored with state and non-state partners.

In response to member country needs and regional priorities, this strategy is timely in providing an improved understanding and analysis of FLW, and targeted guidance through technical expertise and support that addresses the gap in regional coordination, knowledge sharing, and peer-to-peer learning. Some of the areas targeted for action by Member Nations are data, methodologies, tools for monitoring and reporting, analytical approaches for FLW impacts on climate change and nutrition, and educational tools.

The objectives of the strategy are achievable through the FAO's function of convening, in addition to policy, strategic and technical support to Member Nations in the region. This support includes statistical training, orientation of priorities for improved availability and accessibility of climate friendly technologies for FLW reduction, consumer behavioural change studies and programmes, implementation support for investments and analysis of returns on investments for agro-industry actors and commodities along value chains.

REFERENCES

- Adhikari S. Country report of Nepal. 2006.** In: Management of fruits and vegetables in the asia-pacific region. Asian productivity organization and FAO. 2006. (18) (PDF) Postharvest horticulture in Nepal. Available from: https://www.researchgate.net/publication/336159585_Postharvest_horticulture_in_Nepal [Consulted on 23 November 2020].
- African Union Commission. 2018.** Post-harvest loss management strategy. Available at: https://au.int/sites/default/files/documents/34934-doc-au_post-harvest_loss_management_strategy.pdf (Consulted on 25 November 2020).
- Alexander, P., Brown, C., Arneith, A., Finnigan, J., Moran, D. & Rounsevell, M. D. A. 2017.** Losses, inefficiencies and waste in the global food system. *Agricultural Systems*, 153, 190-200.
- Ali, A. & Shahnewaj. 2017.** Improper Labelling of Manufacturing and Expiry Dates of Food: A Legal and Regulatory Study of Food Quality and Food Waste in Bangladesh (August 2, 2017). *Australian Journal of Asian Law*, Vol. 18, No. 1, article 3, 2017, Available at SSRN: <https://ssrn.com/abstract=3012403>
- Anríquez, G., Foster, W., Santos-Rocha, J., Ortega, J. & Jansen, S. 2019.** Refining the definition of food loss and waste from an economic perspective: producers, intermediaries, and consumers as key decision makers. Santiago, Department of Agricultural Economics, Pontifical Catholic University of Chile
- APEC Multi-Year Project: M SCE 02 2013A (Strengthening Public-Private Partnership to Reduce Food Losses in the Supply Chain). 2018.** Available at: <https://www.apec.org/Publications/2018/09/APEC-Survey-Report-on-Feasible-Solutions-for-Food-Loss-and-Waste-Reduction>
- Asian Productivity Organization. 2006.** Reports of the APO seminar on Reduction of Postharvest Losses of Fruit and Vegetables held in India, 5-11 October 2004 and Marketing and Food Safety: Challenges in Postharvest Management of Agricultural/Horticultural Products in Islamic Republic of Iran, 23-28 July 2005. Available at: https://www.apo-tokyo.org/00e-books/AG-18_PostHarvest/AG-18_PostHarvest.pdf#page=19 (Consulted on 25 November 2020)
- Aulakh, J., & Regmi, A. 2013.** Post-harvest food losses estimation-development of consistent methodology. *In Selected Poster Prepared for Presentation at the Agricultural & Applied Economics Association's 2013 AAEA & CAES Joint Annual Meeting.*
- Australian Government. 2017.** National Food Waste Strategy. Halving Australia's Food Waste by 2030.
- Barrera, E.L. & Hertel, T. 2020.** Global food waste across the income spectrum: Implications for food prices, production and resource use. *Food Policy*, p.101874. <https://www.sciencedirect.com/science/article/pii/S0306919220300762>
- Baig, M., Al-Zahrani, H., Schneider, F., Straquadine, G., & Mourad, M. 2019.** Food waste posing a serious threat to sustainability in the Kingdom of Saudi Arabia – A systematic review, *Saudi Journal of Biological Sciences*, Volume 26, Issue 7, 2019, Pages 1743-1752, ISSN 1319-562X, <https://doi.org/10.1016/j.sjbs.2018.06.004>
- Bharucha, J. 2018.** “Tackling the challenges of reducing and managing food waste in Mumbai restaurants”, *British Food Journal*, Vol. 120 No. 3, pp. 639-649. <https://doi.org/10.1108/BFJ-06-2017-0324>
- Cattaneo, A., Sánchez, M.V., Torero, M. and Vos, R., 2021.** Reducing food loss and waste: Five challenges for policy and research. *Food Policy*, 98, p.101974.
- Chege, C. and Carson, M. 2017.** Food Loss and Waste Africa, Intelligence Report 9. The Rockefeller Foundation. Dalberg Intelligence. Available at: <https://dalberg.com/wp-content/uploads/2017/06/FOOD-LOSS-QUARTERLY-VOL9.pdf> (Consulted on 25 November 2020).
- Chen, C., Chaudhary, A. & Mathys, A. 2020.** Nutritional and environmental losses embedded in global food waste. *Resour. Conserv. Recycl.* 2020, 160, 104912.

- Cheng, S.K. & Dasimapianzi, Dasimapianzi & Xu, Zengrang & Tang, Chengcai & Wang, Lingen & G.C., Dhruva.** 2012. Food waste in catering industry and its impacts on resources and environment in China (Chinese with English abstract). *China Soft Sci.* 7. 106-114.
- Cheng, S., Jin, Z. & Liu, G.** 2018. *China's Urban Food Waste Report*; WWF-China: Beijing, China, 2018.
- Chinese Academy of Sciences.** 2017. *China Must Cut Its Wasteful Ways*. In Chinese Academy of Sciences [online]. [Consulted on 01 October 2021]. Available at: http://english.cas.cn/newsroom/archive/research_archive/rp2017/201702/t20170203_173783.shtml
- Cicatiello, C., Franco, S., Pancino, B., & Blasi, E.** 2016. The value of food waste: An exploratory study on retailing. *Journal of Retailing and Consumer Services*, 30, 96-104.
- Clark, M.A., Domingo, N.G., Colgan, K., Thakrar, S.K., Tilman, D., Lynch, J., Azevedo, I.L. & Hill, J.D.** 2020. Global food system emissions could preclude achieving the 1.5° and 2° C climate change targets. *Science*, 370(6517), pp.705-708.
- Clercq, D.D., Wen, Z., & Fan, F.** 2017. Performance evaluation of restaurant food waste and biowaste to biogas pilot projects in China and implications for national policy. *Journal of environmental management*, 189, 115-124.
- Corrado, S., Ardente, F., Sala, S., & Saouter, E.** 2017. Modelling of food loss within life cycle assessment: From current practice towards a systematisation. *Journal of cleaner production*, 140, 847-859.
- Craig E Landry, Travis A Smith** 2019. Demand for Household Food Waste, *Applied Economic Perspectives and Policy*, Volume 41, Issue 1, March 2019, Pages 20–36, <https://doi.org/10.1093/aapp/ppy037>
- Crumpler, K., Dasgupta, S., Federici, S., Meybeck, M., Bloise, M., Slivinska, V., Salvatore, M., Damen, B., Von Loeben, S., Wolf, J. and Bernoux, M.** 2020. Regional analysis of the nationally determined contributions in Asia – Gaps and opportunities in the agriculture and land use sectors. *Environment and Natural Resources Management Working Paper No. 78*. Rome, FAO. <https://doi.org/10.4060/ca7264en>
- Delgado, L., Torero, M. and Schuster, M.** 2020. Clarifying the problem of food loss and waste to improve food and nutrition security. Available at: https://www.g20-insights.org/policy_briefs/clarifying-the-problem-of-food-loss-and-waste-to-improve-food-and-nutrition-security/
- Delgado, L., Schuster, M. & Torero, M.** 2017. *Reality of Food Losses: A New Measurement Methodology*.
- Deloitte.** 2015. *Reducing Food Loss Along African Agricultural Value Chains*. Available at: https://www2.deloitte.com/content/dam/Deloitte/za/Documents/consumer-business/ZA_FL1_ReducingFoodLossAlongAfricanAgriculturalValueChains.pdf
- Dhaka Tribune, ODI, Yale University & Youth Policy Forum.** 2020. Targeting Covid-19 relief payments in Bangladesh. (Consulted on 28 October 2020) Available at: www.eventbrite.com/e/targeting-covid-19-reliefpayments-in-bangladesh-tickets-104240911372#
- Dickella, P., Liu, C., Watabe, A. Sahakian, M., Soma, T., Shenoy, M., Favis, A., Saloma-Akpedonu, C., & Yagasa, R.** 2020. Apprehending food waste in Asia: Policies, practices and promising trends (Published in *Routledge Handbook of Food Waste*. 2020, p. 187-206).
- Dou, Z., Ferguson, J. D., Galligan, D. T., Kelly, A. M., Finn, S. M., & Giegengack, R.** 2016. Assessing US food waste and opportunities for reduction. *Global Food Security*, 8, 19-26.
- El Bilali, H. and Ben Hassen, T.** 2020. Food Waste in the Countries of the Gulf Cooperation Council: A Systematic Review. *Foods*, 9(4), p.463.
- Environment Department.** 2010. *Bangkok waste management* [in Thai]. The Bangkok Metropolitan Administration
- Environment Department.** 2018. *How the garbage and waste in Bangkok have been handled in the upstream, midstream and downstream* [in Thai]. The Bangkok Metropolitan Administration.

- European Commission.** 2017. Notice of 16.10.2017 EU guidelines on food donation. Available at: https://ec.europa.eu/food/sites/food/files/safety/docs/fw_eu-actions_food-donation_eu-guidelines_en.pdf (Consulted on 25 November 2020).
- Every Meal Matters.** 2020. Food donation guidelines. Available at: https://www.fooddrinkeurope.eu/uploads/publications_documents/6194_FoodDrink_Europe_Every_Meal_Matters_screen.pdf (Consulted on 25 November 2020).
- Lin, F., Yang, Z.C. and Jia, T.,** 2016. Optimal pricing and ordering policies for non instantaneous deteriorating items with price dependent demand and maximum lifetime. In Proceedings of the 6th international Asia conference on industrial engineering and management innovation (pp. 411-421). Atlantis Press, Paris.
- Fabi, C. & English, A.** 2018. Methodological proposal for monitoring SDG target 12.3. The global food loss index design, data collection methods and challenges. FAO, Rome, Italy. Available at: <http://www.fao.org/3/CA2640EN/ca2640en.pdf> (Consulted on 18 October 2019).
- FAO.** 2011. Global food losses and food waste - Extent, causes and prevention. Rome, FAO. 29 pp. (also available at: <http://www.fao.org/docrep/014/mb060e/mb060e00.pdf>).
- FAO.** 2013. Food Wastage Footprint: Impacts on Natural Resources. FAO, Rome, Italy.
- FAO.** 2014a. Methodology- Food Loss Analysis: Causes and Solutions. Case studies in the Small-scale Agriculture and Fisheries Subsectors.
- FAO.** 2014b. Working Paper - Definitional Framework of Food Loss.
- FAO.** 2014c. Global Initiative on Food Loss and Waste Reduction.
- FAO.** 2014d. Mitigation of Food Wastage Societal Costs and Benefits. Rome, FAO.
- FAO.** 2015a. Technical manual for the construction and use of family-sized metal silos to store cereals and grain legumes, by Mejía-Lorío, D., Howell, M. & Arancibia, A. Rome, Italy
- FAO.** 2015b. State of Food Insecurity in the World 2015. FAO, Rome, Italy.
- FAO.** 2015c. Regional strategic Framework Reducing Food losses and waste in the near east and North Africa region.
- FAO.** 2015d. Food Wastage Footprint and Climate Change. Rome, FAO.
- FAO.** 2016. Food Loss Analysis: Causes and Solutions. Case studies in the Small-scale Agriculture and Fisheries Subsectors. Methodology.
- FAO.** 2018a. Save Food Launched in China.
- FAO.** 2018b. Food loss analysis: causes and solutions - Case study on the maize value chain in the Democratic Republic of Timor-Leste. Rome. 44 pp. Licence: CC BY-NC-SA 3.0 IGO. Available at: <http://www.fao.org/3/BU679EN/bu679en.pdf> (Consulted on 10 November 2020).
- FAO.** 2018d. Food loss analysis: causes and solutions - Case study on the mango value chain in the Republic of India. Rome. 58 pp. Licence: CC BY-NC-SA 3.0 IGO. Available at: <http://www.fao.org/3/BU688EN/bu688en.pdf> (Consulted on 09 November 2020).
- FAO.** 2018a. Food Loss and Waste and the Right to Adequate Food: Making the Connection. FAO, Rome, 48pp. Licence: CC BY-NC-SA 3.0 IGO.
- FAO.** 2019. The State of Food and Agriculture 2019. Moving forward on food loss and waste reduction. Rome. Licence: CC BY-NC-SA 3.0 IGO.
- FAO.** 2020a. Food loss and waste in fish value chains. In: FAO [online]. [Cited 18 March 2020]. www.fao.org/flw-in-fish-value-chains/en/
- FAO.** 2020b. The State of World Fisheries and Aquaculture 2020. Sustainability in action. Rome. <https://doi.org/10.4060/ca9229en>

- FAO.** 2020c. Impact of COVID-19 on informal workers. Available at: <http://www.fao.org/3/ca8560en/CA8560EN.pdf> (Consulted on 25 November 2020).
- FAO.** 2020d. The impact of COVID-19 on food and agriculture in Asia and the Pacific and FAO's response <http://www.fao.org/3/nd476en/nd476en.pdf> (Consulted on 25 November 2020).
- FAO.** 2020e. The State of World Fisheries and Aquaculture 2020. Sustainability in action. Rome. Available at: <https://doi.org/10.4060/ca9229en> (Consulted on 25 November 2020).
- FAO, UNICEF, WFP and WHO.** 2021. Asia and the Pacific Regional Overview of Food Security and Nutrition 2020: Maternal and child diets at the heart of improving nutrition. Bangkok, FAO.
- FAO/LEI.** 2015. Potential impacts on sub-Saharan Africa of reducing food loss and waste in the European Union – A focus on food prices and price transmission effects, by Rutten, M., Verma, M., Mhlanga, N. & Bucatariu, C. Rome, Italy.
- FAO, IFAD, UNICEF, WFP and WHO.** 2019. The State of Food Security and Nutrition in the World 2019. Safeguarding against economic slowdowns and downturns. Rome, FAO. Licence: CC BY-NC-SA 3.0 IGO.
- FAO and WHO.** 2019. Sustainable healthy diets – Guiding principles. Rome. Available at: <http://www.fao.org/3/ca6640en/ca6640en.pdf> (Consulted on 14 November 2020)
- Feedback.** 2015. Food waste in Kenya uncovering food waste in the horticultural export supply chain. Available at: https://feedbackglobal.org/wp-content/uploads/2015/07/Food-Waste-in-Kenya_report-by-Feedback.pdf
- Flanagan, K., Robertson, K. & Hanson, C.** 2019. Reducing Food Loss and Waste: Setting a Global Action Agenda. WRI Publications. 10.46830/wriipt.18.00130.
- Feed Africa.** Strategy for agricultural transformation in Africa 2016-2025. 2016. Available at : https://www.afdb.org/fileadmin/uploads/afdb/Documents/Generic-Documents/Feed_Africa_-_Strategy_for_Agricultural_Transformation_in_Africa_2016-2025.pdf (Consulted on 25 November 2020).
- Fox, E.L., Davis, C., Downs, S.M., Schultink, W. and Fanzo, J.,** 2019. Who is the woman in women's nutrition? A narrative review of evidence and actions to support women's nutrition throughout life. Current developments in nutrition, 3(1), p.nzy076.
- Galford, G.L., Peña, O., Sullivan, A.K., Nash, J., Gurwick, N., Pirolli, G., Richards, M., White, J. & Wollenberg, E.** 2020. Agricultural development addresses food loss and waste while reducing greenhouse gas emissions, Science of The Total Environment, Volume 699, 2020, 134318, ISSN 0048- 9697, <https://doi.org/10.1016/j.scitotenv.2019.134318>
- Global Food Banking Network.** 2015. 10 Things You Should Know about GFN's New Member Food Bank in Shanghai. Retrieved from <https://www.foodbanking.org/10-things-you-should-know-about-gfns-new-member-food-bank-in-shanghai> [Consulted on 1 Oct 2018]
- Global Food Banking Network.** 2018. The Global FoodBanking Network Welcomes its First Member from Mainland China. Retrieved from <https://www.foodbanking.org/the-global-foodbanking-network-welcomes-its-first-member-from-mainland-china> [Consulted on 1 Oct 2018]
- Global Panel on Agriculture and Food Systems for Nutrition.** 2018. Preventing nutrient loss and waste across the food system: Policy actions for high-quality diets. Policy Brief No. 12. London, UK.
- Goldwater, A.A., Lacap, A.T., Lubaton, C.D.S., Monterde, V.G., Benitez, V.M.M., Valida, A.D., Sudaria, E.E., Joyce, U.D., San Tram, A., Mott, K. & Perkins, M.** 2019. project Improved postharvest management of fruit and vegetables in the Southern Philippines and Australia. Available at: https://aci.gov.au/sites/default/files/project-page-docs/final_report_hort-2012-098.pdf
- Government of Nepal.** 2015. Constitution of Nepal, 2015. Constitution Secretariat, Singh Durbar, Nepal
- Grandhi, B. & Singh, J.A.** 2016. What a Waste! A Study of Food Wastage Behavior in Singapore, Journal of Food Products Marketing, 22:4, 471-485, DOI: 10.1080/10454446.2014.885863

- Gu, B., Wang, H., Chen, Z., Jiang, S., Zhu, W., Liu, M., Chen, Y., Wu, Y., He, S., Cheng, R., Yang, J. & Bi, J.** 2015. Characterization, quantification and management of household solid waste: A case study in China. *Resources, Conservation and Recycling*, 98, 67-75.
- Gu, W.** 2014. Beijing's Corruption Crackdown is a Boon for Bargain-Hunting Chinese. *Wall Street Journal*. Retrieved from <https://www.wsj.com/articles/no-headline-available-1389868562> [Consulted on 1 Oct 2018]
- Hanson, C. & Mitchell, P.** 2017. The Business Case for Reducing Food Loss and Waste. Washington, DC: Champions 12.3. Available at: <https://champions123.org/sites/default/files/2020-08/business-case-for-reducing-food-loss-and-waste.pdf> (Consulted on 09 November 2020).
- Hatton, C.** 2013. Operation Empty Plate: China's food waste campaigner. *BBC News*, Beijing. Retrieved from <https://www.bbc.com/news/world-asia-china-21711928> [14 Sep 2018]
- High-Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security (HLPE).** 2014. Food losses and waste in the context of sustainable food systems, Rome.
- High-Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security (HLPE).** 2017. Nutrition and food systems. Rome. Available at: <http://www.fao.org/3/a-i7846e.pdf> (Consulted on 16 November 2020).
- Hirvonen, K., de Brauw, A. and Abate, G.T.** 2021. Food Consumption and Food Security during the COVID-19 Pandemic in Addis Ababa. *Amer. J. Agr. Econ.*, 103: 772-789. <https://doi.org/10.1111/ajae.12206>
- Hu, X., M. Zhang, J. Yu, and G. Zhang.** 2012. Food waste management in China: status, problems and solutions (in Chinese). *Acta Ecologica Sinica* 32(14): 4575-4584.
- International Fund for Agricultural Development (IFAD).** 2019. The Food Loss Reduction Advantage: Building sustainable food systems. Rome. www.ifad.org/documents/38714170/41335091/food_loss_advantage.pdf/373e787f-fc6f-0426-eea0-d730f79d38c3
- International Labour Organization (ILO).** 2020. COVID-19 and the impact on agriculture and food security. Available at: https://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---sector/documents/briefingnote/wcms_742023.pdf (Consulted on 25 November 2020)
- Islam, M.S. & Kieu, E.** 2020. Tackling Regional Climate Change Impacts and Food Security Issues: A Critical Analysis across ASEAN, PIF and SAARC. *Sustainability*, 12(3), p.883.
- Jörissen J, Priefer C, Bräutigam K-R.** 2015. Food Waste Generation at Household Level: Results of a Survey among Employees of Two European Research Centers in Italy and Germany. *Sustainability*; 7(3):2695-2715. <https://doi.org/10.3390/su7032695>
- Kaza, S., Yao, L., Bhada-Tata, P. and Van Woerden, F.,** 2018. What a waste 2.0: a global snapshot of solid waste management to 2050. World Bank Publications.
- Le Roux, B., Van der Laan, M., Vahrmeijer, T., Annandale, J.G. & Bristow, K.L.** 2018. Water footprints of vegetable crop wastage along the supply chain in Gauteng, South Africa. *Water*, 10(5), p.539.
- Lee, W., Paratore, G., Tung J.** 2019. Evaluation of Micronutrient Losses from Postharvest Food Losses (PHL) in Kenya, Cameroon and India –Implications on Micronutrient Deficiencies in Children Under 5 years of age. *FAO* 2019 (forthcoming)
- Leung, H.** 2015. "No Doggy Bag Please: Chinese Attitudes on Food Waste" Master's thesis, Royal Roads University, Victoria, Canada.
- Lipinski, B., Hanson, C., Lomax, J., Kitinoja, L., Waite, R. & Searchinger, T.** 2013. Reducing Food Loss and Waste. Working Paper. World Resources Institute, 22. Retrieved from: http://pdf.wri.org/reducing_food_loss_and_waste.pdf
- Liu, C. & Nguyen, T.T.** 2020. Evaluation of Household Food Waste Generation in Hanoi and Policy Implications towards SDGs Target 12.3. *Sustainability*, 12(16), p.6565. <https://www.mdpi.com/2071-1050/12/16/6565>

- Liu, C., Hotta, Y., Santo, A., Hengesbaugh, M., Watanabe, A., Totoki, Y., Allen, D. & Bengtsson, M.** 2016. Food waste in Japan: Trends, current practices and key challenges, *Journal of Cleaner Production*, Volume 133, 2016, Pages 557-564, ISSN 0959-6526, <https://doi.org/10.1016/j.jclepro.2016.06.026>.
- Liu, G.** 2014. Food Losses and Food Waste in China: A First Estimate. OECD Food, Agriculture and Fisheries Papers, No. 66, OECD Publishing. Available at: <http://dx.doi.org/10.1787/5jz5sq51731q-en>
- Liu, G., Liu, X. & Cheng, S.** 2013. "Food Security: Curb China's Rising Food Wastage" *Nature* 498. At: <http://www.nature.com/nature/journal/v498/n7453/full/498170c.html>
- Liu, X., Tang, O., & Huan, P.** 2008. Dynamic pricing and ordering decision for the perishable food of the supermarket using RFID technology *Asia Pac. J. Mark. Logist.*, 20 (2008), pp. 7-22.
- Magistad, M.A.** 2013. No-waste lunch: China's "Clean Your Plate" campaign. Public Radio International (PPI)'s The World. Retrieved from <https://www.pri.org/stories/2013-07-22/no-waste-lunch-chinas-clean-your-plate-campaign> [1 Oct 2018]
- Martin-Rios, C., Zizka, L., Varga, P. and Pasamar, S.,** 2020. KITRO: technology solutions to reduce food waste in Asia-Pacific hospitality and restaurants. *Asia Pacific Journal of Tourism Research*, 25(10), pp.1128-1135.
- Min, H.** 2015. Local NGO sets up first food bank in the city. *Shanghai Daily*. Retrieved from <https://archive.shine.cn/metro/society/Local-NGO-sets-up-first-food-bank-in-the-city/shdaily.shtml> [1 Oct 2018]
- Ministry of Agricultural Development (MoAD), Government of Nepal.** 2013. Agricultural Policies. Ministry of Agriculture Development, Government of Nepal
- Ministry of Agricultural Development (MoAD), Government of Nepal.** 2014. Agriculture Development Strategy (ADS), Ministry of Agricultural Development, Government of Nepal.
- Miroso, M., Yip, R. & Lentz, G.** 2018. Content Analysis of the 'Clean Your Plate Campaign' on Sina Weibo. *Journal of Food Products Marketing*, 24(5), 539-562.
- Neff, R.A., Spiker, M., Rice, C., Schklair, A., Greenberg, S. and Leib, E.B.** 2019. Misunderstood food date labels and reported food discards: A survey of US consumer attitudes and behaviors. *Waste management*, 86, pp.123-132.
- Oelofse, S., Nahman, A., Barjees Baig, M., Saleemdeeb, R., Nizami, A-S. & Reynolds, C.** 2020. ORCID: 0000-0002-1073-7394 (2020). Food Waste Within South Africa and Saudi Arabia. In: *Routledge Handbook of Food Waste*. (pp. 207-224). Routledge. ISBN 9781138615861
- Okawa, K.** 2015. (2015-03-05), "Market and Trade Impacts of Food Loss and Waste Reduction", OECD Food, Agriculture and Fisheries Papers, No. 75, OECD Publishing
- Panuwat, O.** 2016. Garbage and waste management in Bangkok and the Community Base Solid Waste Management (CBM) [in Thai]. Environment Department, The Bangkok Metropolitan Administration.
- Papargyropoulou, E., Lozano, R., Steinberger, J. K., Wright, N. & bin Ujang, Z.** 2014. The food waste hierarchy as a framework for the management of food surplus and food waste. *Journal of Cleaner Production*, 76, 106-115.
- Parfitt, J., Barthel, M. & Macnaughton, S.** 2010. Food waste within food supply chains: quantification and potential for change to 2050. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 365(1554), 3065-3081.
- Porpino, G., Parente, J. & Wansink, B.** 2015. Food waste paradox: Antecedents of food disposal in low income households. *International Journal of Consumer Studies*. 39. 10.1111/ijcs.12207.
- Post-harvest Management Directorate.** 2017. Annual Report. Post-harvest Management Directorate, Ministry of Agriculture Development, Nepal.
- Ronzon T., Lusser M., Klinkenberg M. (ed.), L. Landa, J. Sanchez Lopez (ed.), R. M'Barek, G. Hadjamu (ed.), A. Belward (ed.), A. Camia (ed.), J. Giuntoli, J. Cristobal, C. Parisi, E. Ferrari, L. Marelli, C. Torres de Matos, M. Gomez Barbero, E. Rodriguez Cerezo.** 2017. Bioeconomy Report 2016. JRC Scientific and Policy Report. EUR 28468 EN

- Saxena, Lopamudra & Tornaghi, Chiara.** 2018. The Emergence of Social Supermarkets in Britain: Food poverty, Food waste and Austerity Retail.
- Schuster, M. & Torero, M.** 2016. "Reducing food loss and waste," IFPRI book chapters, in: 2016 Global Food Policy Report, chapter 3, pages 22-31, International Food Policy Research Institute (IFPRI).
- Segrè, A., Falasconi, L., Politano, A., & Vittuari, M.** 2014. Background paper on the economics of food loss and waste.
- Serafini, M., Lee, T. K. W., Toti, E., Bucatariu, C., Fonseca, J.M., van Otterdijk, R.,** 2015. Global Variations in Micronutrient Losses in the Fruit and Vegetables Supply Chains. Abstract # ADM1095, P. 221. Proceedings of The 1st International Congress on Postharvest Loss Prevention: Developing Measurement Approaches and Intervention Strategies for Smallholders 2015; Rome, Italy: FAO.
- Setti, M., Falasconi, L., Segrè, A., Cusano, I. & Vittuari, M.** 2016. Italian consumers' income and food waste behavior. *British Food Journal*. 118. 1731-1746. 10.1108/BFJ-11-2015-0427.
- Sharma, H.B., Vanapalli, K.R., Cheela, V.R.S., Ranjan, V.P., Jaglan, A.K., Dubey, B., Goel, S. & Bhattacharya, J.** 2020. Challenges, opportunities, and innovations for effective solid waste management during and post COVID-19 pandemic. *Resources, Conservation and Recycling*, 162: 105052.
- Sheahan, M., Barrett, C.B.** 2017. Review: Food loss and Waste in Sub-Saharan Africa / *Food Policy* 70 (2017) 1-12.
- Sinha, A.; Sengupta, T.; Saha, T.** 2020. Technology policy and environmental quality at crossroads: Designing SDG policies for select Asia Pacific countries, *Technological Forecasting and Social Change*, Volume 161, 2020, 120317, ISSN 0040-1625, <https://doi.org/10.1016/j.techfore.2020.120317>.
- Springmann, M., Clark, M., Mason-D'Croz, D., Wiebe, K., Bodirsky, B.L., Lassaletta, L., De Vries, W., Vermeulen, S.J., Herrero, M., Carlson, K.M. and Jonell, M.,** 2018. Options for keeping the food system within environmental limits. *Nature*, 562(7728), pp.519-525.
- Tammara Soma.** 2020. Space to waste: the influence of income and retail choice on household food consumption and food waste in Indonesia, *International Planning Studies*, 25:4, 372-392, DOI: 10.1080/13563475.2019.1626222
- The Global Food Donation Policy Atlas.** Available at: https://www.foodbanking.org/wp-content/uploads/2020/10/Atlas_1-pager_updated-Sept.-20.pdf (Consulted on 25 November 2020)
- Thi, N. B. D., Kumar, G. & Lin, C. Y.** 2015. An overview of food waste management in developing countries: current status and future perspective. *Journal of Environmental Management*, 157, 220-229
- Timmermans, A. J. M., Ambuko, J., Belik, W. & Huang, J.** 2014. Food losses and waste in the context of sustainable food systems (No. 8). CFS Committee on World Food Security.
- Torero, M., Schuster, M and Delgado.** 2019. The Reality of Food Losses: A New Measurement Methodology. Paper presented at the 38th International conference of Agricultural Economists. Vancouver August 2018
- Tsai, W. C., Chen, X. & Yang, C.** 2020, Consumer Food Waste Behavior among Emerging Adults: Evidence from China. *Foods* 2020, 9, 961.
- United Nations Environment Programme (UNEP).** 2021. Food Waste Index Report 2021. Nairobi.
- United States Environmental Protection Agency (EPA).** 2019a. Sustainable Management of Food Basics. Retrieved from the Environmental Protection Agency website: <https://www.epa.gov/sustainable-management-food/sustainable-management-food-basics>
- United States Environmental Protection Agency (EPA).** 2019b. Methane Emissions from Landfills. Retrieved from the Environmental Protection Agency website: <https://www.epa.gov/lmop/basic-information-about-landfill-gas>
- Vanapalli, K.R., Sharma, H.B., Ranjan, V.P., Samal, B., Bhattacharya, J., Dubey, B.K. & Goel, S.** 2020. Challenges and strategies for effective plastic waste management during and post COVID-19 pandemic. *Science of The Total Environment*, 750: 141514.

- Wang, L. E., Liu, G., Liu, X., Liu, Y., Gao, J., Zhou, B., Gao, S. & Cheng, S.** 2017. The weight of unfinished plate: A survey-based characterization of restaurant food waste in Chinese cities. *Waste Management*, 66, 3-12.
- Wing, Y. M., Yu, B. M. & Ming, H. W.** 2018/ Use of food waste, fish waste and food processing waste for China's aquaculture industry: Needs and challenge, *Science of The Total Environment*, Volumes 613-614, 2018, Pages 635-643, ISSN 0048-9697, <https://doi.org/10.1016/j.scitotenv.2017.08.321>.
- World Business Council for Sustainable Development (WBCSD).** 2020. A Recipe to Reduce Food Loss and Waste. News article. 2020. Available at: <https://www.bcg.com/publications/2020/recipe-to-reduce-food-loss-and-waste>
- World Bank.** 2020. Addressing Food Loss and Waste: A Global Problem with Local Solutions Available at: <https://openknowledge.worldbank.org/bitstream/handle/10986/34521/Addressing-Food-Loss-and-Waste-A-Global-Problem-with-Local-Solutions.pdf?sequence=1&isAllowed=y> (Consulted on 07 January 2020)
- Wu, J.** 2012. Research on the optimization of grain reserve system based on food security thesis, Huazhong Agricultural University.
- Wu, N.** 2018. Analysis of China's food security situation and coping strategies [J]. *Shopping mall modernization*. (3): 17-18.
- Yalch T., Lofthouse J. & Nordhagen, S.** 2020. Creating alliances and fostering innovations to reduce postharvest food loss: Experiences from GAIN's Postharvest Loss Alliances for Nutrition. Global Alliance for Improved Nutrition Working Paper #9. Geneva, Switzerland, 2020. DOI: <https://doi.org/10.36072/wp.9>
- Yu, Y. & Jaenicke, E.C.** 2020. Estimating food waste as household production inefficiency. *American Journal of Agricultural Economics*, 102(2), pp.525-547. <https://onlinelibrary.wiley.com/doi/10.1002/ajae.12036>

ANNEX 1:

Steps for compiling national and global food loss indices

The Food Loss Index (SDG 12.3.1.a)²⁰³ at the country level is compiled in three steps:

Step 1: Compile percentage losses of each commodity l_{ijt}

The loss percentages l_{ijt} by country (i), commodity (j) and year (t) are the first variable to be obtained for the indicator. Losses can be either measured directly through representative sample surveys along the supply chain, or they can be modelled through the methodology provided by FAO. Loss percentages are the final output of the whole data collection and the central piece of the methodology.

Step 2: Compile the Food Loss Percentage of a country

The Food Loss Percentage is the weighted average of the loss percentage of all the commodities in a given country, where the weights are equal to the commodities' value of production. The Food Loss Percentage (FLP) for a country (i), in a year (t) is defined as follows:

$$FLP_{it} = \frac{\sum_j l_{ijt} * (q_{ijt_0} * p_{jt_0})}{\sum_j (q_{ijt_0} * p_{jt_0})}$$

Where:

l_{ijt} is the loss percentage (estimated or observed).

i = country, j = commodity, t = year.

t_0 is the base year (set at 2015 for the moment).

q_{ijt_0} is the production plus import quantities by country, commodity in the base period.

p_{jt_0} is the international dollar price by commodity for the base period.

Step 3: Compile the FLI as the ratio between two food-loss percentages

The country-level Food Loss Indices are simply equal to the ratio of the Food Loss Percentage in the current period and the FLP in the base period multiplied by 100:

$$FLI_{it} = \frac{FLP_{it}}{FLP_{it_0}} * 100$$

Where, FLP_{it} is the country's Food Loss Percentage

Global Food Loss Index formula and compilation: aggregating countries FLI

Countries' Food Loss Indices can be aggregated at the global and regional levels into the Global Food Loss Index, GFLI, and Regional Food Loss Index, respectively, for international monitoring. The GFLI is a weighted average of the countries' FLI using weights equal to the countries' total value of agricultural production in the base period. The formula is:

$$GFLI_t = \frac{\sum_{i=1}^G FLI_{it} * w_i}{\sum_{i=1}^G w_i} * 100$$

Where: w_i is the total value of agricultural production of country i at international dollar prices in the base period.

Concurrently, a Food Loss Percentage (FLP) can be aggregated into a Global Food Loss Percentage (GFLP) or a regional (RFLP) percentage, using the same formula and weights:

$$GFLP_t = \frac{\sum_{i=1}^G FLP_{it} * w_i}{\sum_{i=1}^G w_i}$$

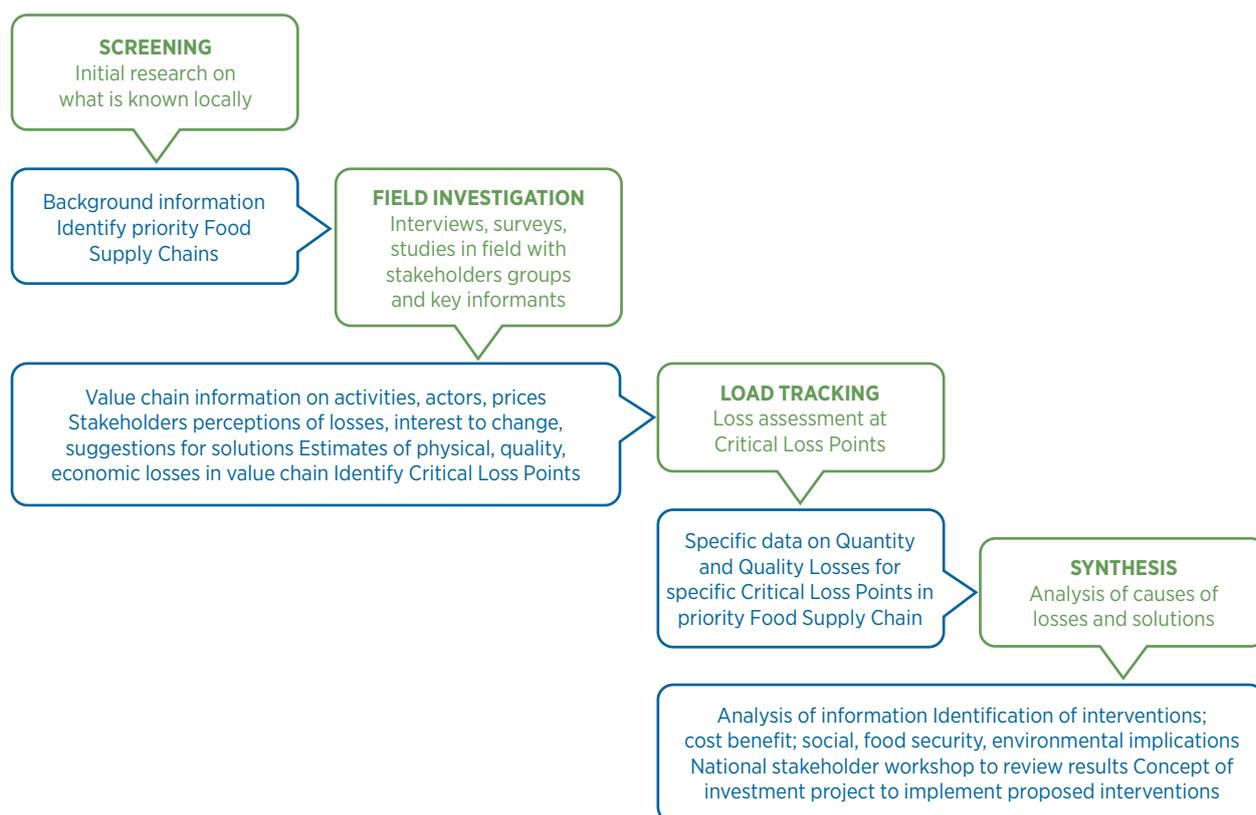
Where: w_i is the total value of agricultural production of country i at international dollar prices in the base period.

The same formulae apply when compiling regional indices or Food Loss Percentages. The same formulae apply at the regional level to compile the Regional Food Loss Index (RFLI) and Regional Food Loss Percentage (RFLP).

ANNEX 2: The FAO methodology for food loss assessment and finding solutions at the food supply chain level

An effective supply chain food loss assessment²⁰⁴ involves collecting and analysing data. Food loss assessments should be carried out using qualitative

and quantitative field methods. The results obtained can subsequently be used to formulate solutions to food losses.



SOURCE: <http://www.fao.org/3/nc562en/nc562en.pdf>

The method includes:

a. Preliminary Screening of Food Losses (Screening)

Screening based on secondary data, documentation and reports, and expert consultation by phone, email, or in person, without travel to the field.

b. Survey Food Loss Assessment (Survey)

Surveying involves a questionnaire exercise differentiated for producers, processors, handlers and sellers and other knowledgeable persons in the supply chain being assessed, complemented with ample and accurate observations and measurements.

c. Load Tracking and Sampling Assessment (Sampling)

Sampling should be used for quantitative and qualitative analyses at any step in the supply chain.

d. Solution Finding (Synthesis)

Synthesis should be used to develop an intervention programme for food losses, based on the previous assessment methods. This can be broad to include increasingly important elements such as climate change.

ANNEX 3:

Nepal: Issues, strategies and action plans for the reduction of post-harvest losses

Operation	Issue/problem	Strategy	Action plan
Harvesting Index	No established maturity index for vegetables; lack of maturity index for local and export markets	Research with the emphasis on quality, safety and sustainability	Develop maturity indices
	Low adoption of established indices; price and distance to market influence adoption	Develop farmer-friendly harvest indices, conduct extension activities	Create awareness on appropriate harvest indices through training, preparation of manuals, posters, etc.
Harvest methods and time of harvesting	Rough handling; untimely harvesting	Create awareness on appropriate methods and time of harvesting	Conduct training, disseminate information and safety practices
	Lack of appropriate and/or poorly designed harvesting tools, equipment and harvest containers	Research and development focusing on design and efficiency of harvesting tools and equipment	Exposure visits
Field assembling sorting, grading and packing	Inadequate field sorting, grading and packing protocols for commodities that lend well to field packing	Establish sorting, grading and packing protocols for vegetables; educate the farmers and stakeholders	Train farmers and stakeholders; develop and disseminate information materials
Pre-cooling	Lack of pre-cooling facilities	Create conducive policy environment to promote investment and formation of alliances and commodity-based clusters to overcome constraints of limited numbers of facilities	Encourage subsidies from government and investment from the private sector
	Lack of knowledge about pre-cooling technology at a commercial scale; lack of information on cost benefits of pre-cooling technology	Research and development focusing on the use of pre-cooling on a commercial scale	Request technical assistance to obtain cost-benefit information on pre-cooling technology applied on a commercial scale

Operation	Issue/problem	Strategy	Action plan
Grading	Lack of national standards and poor enforcement of standards	Develop national standards	Assessment, research and development, dissemination, implementation and maintenance through training and demonstration, etc.
	Lack of skill, awareness/ financial resources	Capacity building	Awareness, motivation, training and government financial support
Procurement/ packing/ grading facilities	Lack of collection centres/ packinghouses/ grading facilities	Government support for clustering	Identify strategic locations
Packaging, labelling and traceability	Inadequate packing technology/suitable packaging (for transportation, storage, and consumers)	Develop/adapt from existing technologies	Develop suitable packaging technology fit for sites/ commercialization
	Lack of skill and awareness of appropriate use of packaging/ financial resources	Capacity building	Awareness, motivation, training and government financial support for stakeholders for appropriate use of packaging technologies and materials
	Environmental impact of packaging	Government regulations	Develop regulatory policies and regulations
	Lack of suitable labelling and traceability of produce	Formulation of regulatory system	Develop appropriate regulatory policies/ systems
Marketing	Limited market information and lack of marketing strategies	Establish national/regional information networking systems	Develop market information systems and marketing strategies
	Inadequate market infrastructure	Develop market centres at different levels	Develop market information systems and marketing strategies
	Inability to market products in domestic and international markets	Develop strategic alliances with multinational companies and corporations	Publicity and advertising

Operation	Issue/problem	Strategy	Action plan
Transportation	Poor infrastructure and lack of appropriate transport system; lack of refrigerated transport	Encourage investment from private sector and policy support from government	Provide logistics and management to lower costs and facilitate efficient distribution or movement of commodities; conduct cost-benefits studies on efficient and appropriate transport system
	Poor temperature management, loading and unloading practices	Create awareness of proper transport system management	Conduct training, seminars, develop and disseminate information materials
Storage	Shortage of storage facilities at the farm level and refrigerated storage at the markets	Create favourable policy environment for investment research and development to determine cost and benefits of storage systems	Encourage financial support from government and the private sector; conduct cost-benefit analysis on different storage systems
	Poor temperature conditions, sanitation, storage room and facilities	Create awareness of the correct operations and management of storage facilities	Conduct training of storage operators and other handlers
	Lack of knowledge of temperature requirements and ethylene sensitivities of different commodities for mixed ripening and storage	Research and development focusing on temperature, relative humidity, and ethylene sensitivities of different commodities under storage	Conduct studies and disseminate findings
Processing	Limited availability of suitable varieties of processing	Develop suitable varieties; disseminate information to small processors	Collection and introduction of germplasm for breeding programme; dissemination of information
	Inadequate appropriate processing technologies	Research and development	Develop innovative niche products; commercialize indigenous products
	Inadequate commercialization of new technologies and lack of basic infrastructure	Government support (technical policy and infrastructure)	Establish pilot plants; undertake cost-benefits and consumer studies
	Development of novel or niche products	Research and development	Develop innovative niche products; commercialize indigenous products
	Inadequate suitable facilities or infrastructure	Research and development	Develop suitable facilities and infrastructure

ENDNOTES

- ¹ **FAO.** 2019. *The State of Food and Agriculture 2019: Moving forward on food loss and waste reduction*. Rome, FAO. 182 pp. (also available at <https://www.fao.org/3/ca6030en/ca6030en.pdf>)
- ² **Clark, M.A., Domingo, N.G., Colgan, K., Thakrar, S.K., Tilman, D., Lynch, J., Azevedo, I.L. & Hill, J.D.** 2020. Global food system emissions could preclude achieving the 1.5° and 2° C climate change targets. *Science*, 370(6517): 705-708 [online]. <https://pubmed.ncbi.nlm.nih.gov/33154139/>
- ³ **World Bank.** 2020. *Addressing Food Loss and Waste: A Global Problem with Local Solutions*. Washington, DC, World Bank. 128 pp. (also available at [https://openknowledge.worldbank.org/bitstream/handle/10986/34521/Addressing-Food-Loss-and-Waste-A-Global-Problem-with-Local-Solutions.pdf?sequence=1&is](https://openknowledge.worldbank.org/bitstream/handle/10986/34521/Addressing-Food-Loss-and-Waste-A-Global-Problem-with-Local-Solutions.pdf?sequence=1&isAllowed=y))
- ⁴ **CFS & HLPE.** 2020. *Impacts of COVID-19 on food security and nutrition: developing effective policy responses to address the hunger and malnutrition pandemic*. Rome, Committee on World Food Security & High Level Panel of Experts. 24 pp. [Cited 20 November 2020] (also available at <https://www.fao.org/3/cb1000en/cb1000en.pdf>)
- ⁵ **FAO.** 2020. *State of Food and Agriculture in Asia and the Pacific Region, including Future Prospects and Emerging Issues*. FAO. 19 pp. [Cited 20 October 2020]. (also available at <http://www.fao.org/3/nb840en/nb840en.pdf>)
- ⁶ **FAO.** 2020. *Report: Thirty-fifth Session of the FAO Regional Conference for Asia and the Pacific*. FAO. 26 pp. [Consulted on 5 November 2020]. (also available at <http://www.fao.org/3/nd688en/nd688en.pdf>)
- ⁷ **World Bank.** 2020. *Addressing Food Loss and Waste: A Global Problem with Local Solutions*. Washington, DC, World Bank. 128 pp. (also available at <https://openknowledge.worldbank.org/bitstream/handle/10986/34521/Addressing-Food-Loss-and-Waste-A-Global-Problem-with-Local-Solutions.pdf?sequence=1&is>)
- ⁸ **FAO.** 2020. *Food Loss and Waste Measurement Linked to the Food Loss Analysis Methodology*. FAO. 8 pp. [Cited 2 October 2020]. <http://www.fao.org/3/nc079en/nc079en.pdf>
- ⁹ **Mbow, C., Rosenzweig, C., Barioni, L.G., Benton, T.G., Herrero, M., Krishnapillai, M., Liwenga, E. et al.** 2019. Chapter 5: Food Security. In Masson-Delmotte, V., Pörtner, H., Skea, J., Buendía, E.C., Zhai, P., Roberts, D., Shukla, P.R. et al., eds. *Special Report on Climate Change and Land*, pp. 437-550. United Nations Intergovernmental Panel on Climate Change. [Cited 23 October 2019]. https://www.ipcc.ch/site/assets/uploads/2019/08/2f.-Chapter-5_FINAL.pdf
- ¹⁰ **van Dijk, M., Morley, T., Rau, M.L. & Saghai, Y.** 2021. A meta-analysis of projected global food demand and population at risk of hunger for the period 2010–2050. *Nature Food*, 2: 494–501. <https://doi.org/10.1038/s43016-021-00322-9>
- ¹¹ **FAO.** 2019. *The State of Food and Agriculture 2019: Moving forward on food loss and waste reduction*. Rome, FAO. 182 pp. (also available at <https://www.fao.org/3/ca6030en/ca6030en.pdf>)
- ¹² Ibid.
- ¹³ **UNEP.** 2021. *Food Waste Index Report 2021*. Nairobi, United Nations Environment Programme. <https://www.unep.org/resources/report/unep-food-waste-index-report-2021>
- ¹⁴ **FAO.** 2019. *The State of Food and Agriculture 2019: Moving forward on food loss and waste reduction*. Rome, FAO. 182 pp. (also available at <https://www.fao.org/3/ca6030en/ca6030en.pdf>)
- ¹⁵ **HLPE.** 2014. *Food losses and waste in the context of sustainable food systems*. Rome, FAO. (also available at <https://www.fao.org/3/i3901e/i3901e.pdf>)
- ¹⁶ **Feedback Global.** 2015. *Food waste in Kenya: Uncovering food waste in the horticultural export supply chain*. https://feedbackglobal.org/wp-content/uploads/2015/07/Food-Waste-in-Kenya_report-by-Feedback.pdf
- ¹⁷ **Kaza, S., Yao, L., Bhada-Tata, P. & van Woerden, F.** 2018. *What a waste 2.0: a global snapshot of solid waste management to 2050*. World Bank Publications.
- ¹⁸ **Hanson, C. & Mitchell, P.** 2017. *The Business Case for Reducing Food Loss and Waste*. Washington, DC, Champions 12.3. [Cited 9 November 2020]. <https://champions123.org/sites/default/files/2020-08/business-case-for-reducing-food-loss-and-waste.pdf>
- ¹⁹ **World Business Council for Sustainable Development (WBCSD).** 2020. A Recipe to Reduce Food Loss and Waste. In: *WBCSD* [online]. [Cited 7 January 2020]. <https://openknowledge.worldbank.org/bitstream/handle/10986/34521/Addressing-Food-Loss-and-Waste-A-Global-Problem-with-Local-Solutions.pdf?sequence=1&isAllowed=y>
- ²⁰ **Porpino, G., Parente, J. & Wansink, B.** 2015. Food waste paradox: Antecedents of food disposal in low income households. *International Journal of Consumer Studies*. 39.10.1111/ijcs.12207.

- 21 **Setti, M., Falasconi, L., Segrè, A., Cusano, I. & Vittuari, M.** 2016. Italian consumers' income and food waste behavior. *British Food Journal*. 118. 1731-1746. 10.1108/BFJ-11-2015-0427.
- 22 **Jörissen J, Priefer C, Bräutigam K-R.** 2015. Food Waste Generation at Household Level: Results of a Survey among Employees of Two European Research Centers in Italy and Germany. *Sustainability*, 7(3):2695-2715. <https://doi.org/10.3390/su7032695>
- 23 **Landry, C. & Smith, T.** 2019. Demand for Household Food Waste. *Applied Economic Perspectives and Policy*, 41(1): 20–36. <https://doi.org/10.1093/aep/ppy037>
- 24 **Ali, A. & Shahnewaj.** 2017. Improper Labelling of Manufacturing and Expiry Dates of Food: A Legal and Regulatory Study of Food Quality and Food Waste in Bangladesh. *Australian Journal of Asian Law*, 18(1):27-40. <https://ssrn.com/abstract=3012403>
- 25 **Neff, R.A., Spiker, M., Rice, C., Schklair, A., Greenberg, S. & Leib, E.B.** 2019. Misunderstood food date labels and reported food discards: A survey of US consumer attitudes and behaviors. *Waste Management*, 86:123-132.
- 26 **Gao, L., Cheng, S., Cao, X., Zhang, D., Liu, X., Qin, Q. & Liu, Y.** 2013. Food waste in catering industry and its impacts on resources and environment in China. *Journal of Resources and Ecology*. 4(4): 337-343.
- 27 **Grandhi, B. & Singh, J.A.** 2016. What a Waste! A Study of Food Wastage Behavior in Singapore. *Journal of Food Products Marketing*. 22(4): 471-485. DOI: 10.1080/10454446.2014.885863
- 28 **Bharucha, J.** 2018. Tackling the challenges of reducing and managing food waste in Mumbai restaurants. *British Food Journal*. 120(3): 639-649. <https://doi.org/10.1108/BFJ-06-2017-0324>
- 29 **Kaza, S., Yao, L., Bhada-Tata, P. & van Woerden, F.,** 2018. *What a waste 2.0: a global snapshot of solid waste management to 2050*. World Bank Publications.
- 30 **Delgado, L., Torero, M. & Schuster, M.** 2020. Clarifying the problem of food loss and waste to improve food and nutrition security. *G20 Insights*. Available at: https://www.g20-insights.org/policy_briefs/clarifying-the-problem-of-food-loss-and-waste-to-improve-food-and-nutrition-security/
- 31 **FAO.** 2019. *The State of Food and Agriculture 2019: Moving forward on food loss and waste reduction*. Rome, FAO. 182 pp. (also available at <https://www.fao.org/3/ca6030en/ca6030en.pdf>)
- 32 *Ibid.*
- 33 *Ibid.*
- 34 *Ibid.*
- 35 *Ibid.*
- 36 **UNEP.** 2021. *Food Waste Index Report 2021*. Nairobi, United Nations Environment Programme. <https://www.unep.org/resources/report/unep-food-waste-index-report-2021>
- 37 **APEC.** 2018. *APEC Survey Report on Feasible Solutions for Food Loss and Waste Reduction*. <https://www.apec.org/Publications/2018/09/APEC-Survey-Report-on-Feasible-Solutions-for-Food-Loss-and-Waste-Reduction>
- 38 **Cheng, S., Jin, Z. & Liu, G.** 2018. *China's Urban Food Waste Report*. Beijing, WWF China.
- 39 **Chen, C., Chaudhary, A. & Mathys, A.** 2020. Nutritional and environmental losses embedded in global food waste. *Resources, Conservation and Recycling*. 160: 104912.
- 40 **Tsai, W. C., Chen, X. & Yang, C.** 2020. Consumer Food Waste Behavior among Emerging Adults: Evidence from China. *Foods*, 9(7): 961.
- 41 **Flanagan, K., Robertson, K. & Hanson, C.** 2019. *Reducing Food Loss and Waste: Setting a Global Action Agenda*. WRI Publications. 10.46830/wri.rpt.18.00130.
- 42 **Hanson, C. & Mitchell, P.** 2017. *The Business Case for Reducing Food Loss and Waste*. Washington, DC, Champions 12.3. [Cited 9 November 2020]. <https://champions123.org/sites/default/files/2020-08/business-case-for-reducing-food-loss-and-waste.pdf>
- 43 **Clark, M.A., Domingo, N.G., Colgan, K., Thakrar, S.K., Tilman, D., Lynch, J., Azevedo, I.L. & Hill, J.D.** 2020. Global food system emissions could preclude achieving the 1.5° and 2° C climate change targets. *Science*, 370(6517): 705-708 [online]. <https://pubmed.ncbi.nlm.nih.gov/33154139/>
- 44 **World Bank.** 2020. *Addressing Food Loss and Waste: A Global Problem with Local Solutions*. Washington, DC, World Bank. 128 pp. (also available at <https://openknowledge.worldbank.org/bitstream/handle/10986/34521/Addressing-Food-Loss-and-Waste-A-Global-Problem-with-Local-Solutions.pdf?sequence=1&is>)
- 45 **Anríquez, G., Foster, W., Santos-Rocha, J., Ortega, J. & Jansen, S.** 2019. *Refining the definition of food loss and waste from an economic perspective: producers, intermediaries, and consumers as key decision makers*. Santiago, Department of Agricultural Economics, Pontifical Catholic University of Chile.

- 46 **Cattaneo, A., Sánchez, M.V., Torero, M. and Vos, R.** 2021. Reducing food loss and waste: Five challenges for policy and research. *Food Policy*, 98: 101974.
- 47 **Kennedy, G., Ballard, T. and Dop, M.** 2013. *FAO Guidelines for Measuring Household and Individual Dietary Diversity*. Rome, FAO.
- 48 **World Bank.** 2020. *Addressing Food Loss and Waste: A Global Problem with Local Solutions*. Washington, DC, World Bank. 128 pp. (also available at <https://openknowledge.worldbank.org/bitstream/handle/10986/34521/Addressing-Food-Loss-and-Waste-A-Global-Problem-with-Local-Solutions.pdf?sequence=1&is>)
- 49 **Fox, E.L., Davis, C., Downs, S.M., Schultink, W. & Fanzo, J.** 2019. Who is the woman in women's nutrition? A narrative review of evidence and actions to support women's nutrition throughout life. *Current Developments in Nutrition*, 3(1): nzy076. <https://doi.org/10.1093/cdn/nzy076>
- 50 **World Bank.** 2020. *Addressing Food Loss and Waste: A Global Problem with Local Solutions*. Washington, DC, World Bank. 128 pp. (also available at <https://openknowledge.worldbank.org/bitstream/handle/10986/34521/Addressing-Food-Loss-and-Waste-A-Global-Problem-with-Local-Solutions.pdf?sequence=1&is>)
- 51 **Springmann, M., Clark, M., Mason-D'Croz, D., Wiebe, K., Bodirsky, B.L., Lassaletta, L., De Vries, W. et al.** 2018. Options for keeping the food system within environmental limits. *Nature*, 562(7728): 519-525. <https://www.nature.com/articles/s41586-018-0594-0>
- 52 **Yu, Y. & Jaenicke, E.C.** 2020. Estimating food waste as household production inefficiency. *American Journal of Agricultural Economics*. 102(2): 525-547. <https://onlinelibrary.wiley.com/doi/10.1002/ajae.12036>
- 53 **Barrera, E.L. & Hertel, T.** 2020. Global food waste across the income spectrum: Implications for food prices, production and resource use. *Food Policy*, 98: 101874. <https://www.sciencedirect.com/science/article/pii/S0306919220300762>
- 54 **FAO.** 2019. *The State of Food and Agriculture 2019: Moving forward on food loss and waste reduction*. Rome, FAO. 182 pp. (also available at <https://www.fao.org/3/ca6030en/ca6030en.pdf>)
- 55 **HLPE.** 2014. *Food losses and waste in the context of sustainable food systems*. Rome, FAO. (also available at <https://www.fao.org/3/i3901e/i3901e.pdf>)
- 56 **Global Panel on Agriculture and Food Systems for Nutrition.** 2018. *Global Panel on Agriculture and Food Systems for Nutrition* [online]. London. <https://www.glopan.org/>
- 57 **FAO & WHO.** 2019. *Sustainable Healthy Diets: Guiding principles*. Rome. [Cited 14 November 2020]. <http://www.fao.org/3/ca6640en/ca6640en.pdf>
- 58 **FAO, IFAD, UNICEF, WFP and WHO.** 2019. *The State of Food Security and Nutrition in the World 2019: Safeguarding against economic slowdowns and downturns*. Rome, FAO. (also available at <https://www.fao.org/3/ca5162en/ca5162en.pdf>)
- 59 **FAO & WHO.** 2019. *Sustainable Healthy Diets: Guiding principles*. Rome. [Cited 14 November 2020]. <http://www.fao.org/3/ca6640en/ca6640en.pdf>
- 60 **FAO, IFAD, UNICEF, WFP and WHO.** 2019. *The State of Food Security and Nutrition in the World 2019: Safeguarding against economic slowdowns and downturns*. Rome, FAO. (also available at <https://www.fao.org/3/ca5162en/ca5162en.pdf>)
- 61 **Serafini, M., Lee, T. K. W., Toti, E., Bucatariu, C., Fonseca, J.M., & van Otterdijk, R.** 2015. Global Variations in Micro-nutrient Losses in the Fruit and Vegetables Supply Chains. In: *The first international congress on postharvest loss prevention: Developing measurement approaches and intervention strategies for smallholders; Proceedings*. Rome, FAO.
- 62 **Lee, W., Paratore, G., Tung J.** 2019. *Evaluation of Micronutrient Losses from Postharvest Food Losses (PHL) in Kenya, Cameroon and India –Implications on Micronutrient Deficiencies in Children Under 5 years of age*. Rome, FAO (forthcoming).
- 63 **Serafini, M., Lee, T. K. W., Toti, E., Bucatariu, C., Fonseca, J.M., & van Otterdijk, R.** 2015. Global Variations in Micro-nutrient Losses in the Fruit and Vegetables Supply Chains. In: *The first international congress on postharvest loss prevention: Developing measurement approaches and intervention strategies for smallholders; Proceedings*. Rome, FAO.
- 64 **HLPE.** 2014. *Food losses and waste in the context of sustainable food systems*. Rome, FAO. (also available at <https://www.fao.org/3/i3901e/i3901e.pdf>)
- 65 **FAO.** 2019. *The State of Food and Agriculture 2019: Moving forward on food loss and waste reduction*. Rome, FAO. 182 pp. (also available at <https://www.fao.org/3/ca6030en/ca6030en.pdf>)
- 66 **HLPE.** 2017. *Nutrition and food systems: A report by the High Level Panel of Experts on Food Security and Nutrition, September 2017*. Rome. [Cited 16 November 2020]. <http://www.fao.org/3/a-i7846e.pdf>

- 67 **FAO.** 2020. *Report: Thirty-fifth Session of the FAO Regional Conference for Asia and the Pacific*. FAO. 26 pp. [Consulted on 5 November 2020]. (also available at <http://www.fao.org/3/nd688en/nd688en.pdf>)
- 68 **FAO.** 2020. *FAO's Hand-in-Hand Initiative: a New Approach*. <http://www.fao.org/3/nb850en/nb850en.pdf>
- 69 **Hirvonen, K., de Brauw, A. and Abate, G.T.** 2021. Food Consumption and Food Security during the COVID-19 Pandemic in Addis Ababa. *American Journal of Agricultural Economics*, 103(3): 772-789. <https://doi.org/10.1111/ajae.12206>
- 70 **FAO.** 2020. *Mitigating risks to food systems during COVID-19: Reducing food loss and waste*. Rome, FAO. [Cited 20 November 2020]. <https://doi.org/10.4060/ca9056en>
- 71 **HLPE.** 2020. *Impacts of COVID-19 on food security and nutrition: developing effective policy responses to address the hunger and malnutrition pandemic*. Rome.
- 72 **FAO.** 2020. *Food system policy priorities and programmatic actions for healthy diets in the context of COVID-19*. Rome. <https://doi.org/10.4060/ca9512en>
- 73 **Ministry of Agriculture, Livestock, Fisheries and Cooperatives (MALFC).** 2020. *Simple Technologies for Producing Nutritious Foods during COVID 19 Pandemic*. Ministry of Agriculture, Livestock, Fisheries and Cooperative, Government of Kenya. [Cited 28 October 2020]. <https://kilimo.go.ke/wp-content/uploads/2021/01/SIMPLE-TECHNOLOGIES-FOR-PRODUCING-NUTRITIOUS-FOODS-DURING-COVID-19-PANDEMIC.pdf>
- 74 **WHO and FAO.** 2018. *Strengthening nutrition action: A resource guide for countries based on the policy recommendations of the Second International Conference on Nutrition*. WHO. <https://apps.who.int/iris/handle/10665/274739>
- 75 **Milan Urban Food Policy Pact.** 2022. Regional Fora. In: *Milan Urban Food Policy Pact* [online]. Milan, Italy. <https://www.milanurbanfoodpolicypact.org/mufpp-regional-forums/>
- 76 **HLPE.** 2014. *Food losses and waste in the context of sustainable food systems*. Rome, FAO. (also available at <https://www.fao.org/3/i3901e/i3901e.pdf>)
- 77 **Committee on World Food Security (CFS).** *Sustainable Fisheries and Aquaculture for Food Security and Nutrition: Policy recommendations*. Committee on World Food Security. [Cited 16 November 2020]. <http://www.fao.org/3/a-av032e.pdf>
- 78 **FAO.** 2020. *The State of World Fisheries and Aquaculture 2020: Sustainability in action*. Rome, FAO. [Cited 16 November 2020]. <https://doi.org/10.4060/ca9229en>
- 79 **FAO.** 2021. *Voluntary Code of Conduct for Food Loss and Waste Reduction*. <http://www.fao.org/3/nf393en/nf393en.pdf>
- 80 **FAO.** 2022. Food Loss and Waste Database. In: *Food and Agriculture Organization of the United Nations* [online]. Rome. <http://www.fao.org/platform-food-loss-waste/flw-data/en/>
- 81 **FAO.** 2020. FAO to continue to support G20 to address the pandemic and strengthen agri-food systems. <http://www.fao.org/news/story/en/item/1307183/icode/>
- 82 **MACS-G20: Meeting of G20 Agricultural Chief Scientists.** Collaboration Initiative on Food Losses & Food Wastes launched at MACS-G20. In: *MACS-G20: Meeting of G20 Agricultural Chief Scientists* [online]. <https://www.macs-g20.org/about-macs/macs-activities/collaboration-initiative-on-food-losses-food-waste-launched-at-macs-g20/>
- 83 **Delgado, L., Torero, M. & Schuster, M.** 2020. Clarifying the problem of food loss and waste to improve food and nutrition security. *G20 Insights*. https://www.g20-insights.org/policy_briefs/clarifying-the-problem-of-food-loss-and-waste-to-improve-food-and-nutrition-security/
- 84 **FAO.** 2019. *The State of Food and Agriculture 2019: Moving forward on food loss and waste reduction*. Rome, FAO. 182 pp. (also available at <https://www.fao.org/3/ca6030en/ca6030en.pdf>)
- 85 **FAO, PAHO, WFP & UNICEF.** 2020. *Regional Overview of Food Security and Nutrition in Latin America and the Caribbean*. Latin America and the Caribbean – Regional Overview of Food Security and Nutrition. Santiago. <https://doi.org/10.4060/ca6979en>
- 86 **FAO.** 2020. *Transforming food systems for healthy diets for all*. <http://www.fao.org/3/nd021en/nd021en.pdf>
- 87 **FAO, CEPAC, ALADI & CELAC.** 2014. *Food and nutrition security and the eradication of hunger – CELAC 2025: Furthering discussion and regional cooperation*. Santiago, United Nations. <http://www.fao.org/3/a-bo925e.pdf>
- 88 **FAO.** 2019. *The State of Food and Agriculture 2019: Moving forward on food loss and waste reduction*. Rome, FAO. 182 pp. (also available at <https://www.fao.org/3/ca6030en/ca6030en.pdf>)
- 89 **Zorya, S., Morgan, N., Diaz Rios, L., Hodges, R., Bennett, B., Stathers, T., Mwebaze, P. & Lamb, J.** 2011. *Missing food: The case of postharvest grain losses in sub-Saharan Africa*. Washington, DC, The World Bank. <http://www.fao.org/3/at454e/at454e.pdf>

- 90 **El Bilali, H. & Ben Hassen, T.** 2020. Food Waste in the Countries of the Gulf Cooperation Council: A Systematic Review. *Foods*, 9(4): 463.
- 91 **Baig, M., Al-Zahrani, K. H., Schneider, F., Straquadine, G., & Mourad, M.** 2019. Food waste posing a serious threat to sustainability in the Kingdom of Saudi Arabia – A systematic review. *Saudi Journal of Biological Sciences*, 26(7): 1743-1752. <https://doi.org/10.1016/j.sjbs.2018.06.004>
- 92 **FAO.** 2020. *United Nations Decade of Action on Nutrition and Follow-up to the Second International Conference on Nutrition (ICN2)*. <http://www.fao.org/3/nc350en/nc350en.pdf>
- 93 **FAO.** 2019. *The State of Food and Agriculture 2019: Moving forward on food loss and waste reduction*. Rome, FAO. 182 pp. (also available at <https://www.fao.org/3/ca6030en/ca6030en.pdf>)
- 94 **Ronzon, T., Lusser, M., Landa, L., M`barek, R., Giuntoli, J., Cristobal Garcia, J., Parisi, C., et al.** 2017. *Bioeconomy Report 2016*. Luxembourg, Publications Office of the European Union. <https://publications.jrc.ec.europa.eu/repository/handle/JRC103138>
- 95 **European Commission.** 2012. *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and The Committee of the Regions – Innovating for Sustainable Growth: A Bioeconomy for Europe*. Brussels, European Commission. [Cited 10 August 2019].
- 96 **Priefer, C., Jörissen, J., Bräutigam, K.** 2013. *Technology options for feeding 10 billion people: Options for Cutting Food Waste*. European Parliament, Strasbourg, France. 159 pp. [https://www.europarl.europa.eu/RegData/etudes/etudes/join/2013/513515/IPOL-JOIN_ET\(2013\)513515_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/etudes/join/2013/513515/IPOL-JOIN_ET(2013)513515_EN.pdf)
- 97 **European Parliament.** 2017. *European Parliament Resolution of 16 May 2017 on initiative on resource efficiency: reducing food waste, improving food safety (2016/2223(INI))*. European Parliament, Strasbourg, France.
- 98 **European Parliament Committee on the Environment, Public Health and Food Safety.** 2017. REPORT: on reducing food waste, improving food safety. European Parliament, Strasbourg, France. https://www.europarl.europa.eu/doceo/document/A-8-2017-0175_EN.html
- 99 **European Parliament Committee on Agriculture and Rural Development.** 2011. REPORT: on how to avoid food wastage: strategies for a more efficient food chain in the EU. European Parliament, Strasbourg, France.
- 100 **Katsarova, I.** 2016. *Tackling food waste: The EU's contribution to a global issue*. European Parliamentary Research Service, Strasbourg, France. [https://www.europarl.europa.eu/RegData/etudes/BRIE/2016/593563/EPRS_BRI\(2016\)593563_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/BRIE/2016/593563/EPRS_BRI(2016)593563_EN.pdf)
- 101 **Bourguignon, D.** 2016. *Closing the loop: New circular economy package*. European Parliamentary Research Service, Strasbourg, France. https://www.europarl.europa.eu/RegData/etudes/BRIE/2016/573899/EPRS_BRI%282016%29573899_EN.pdf
- 102 **Valant, J.** 2015. *'Best before' date labels: Protecting consumers and limiting food waste*. European Parliamentary Research Service, Strasbourg, France. [https://www.europarl.europa.eu/RegData/etudes/BRIE/2015/548990/EPRS_BRI\(2015\)548990_REV1_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/BRIE/2015/548990/EPRS_BRI(2015)548990_REV1_EN.pdf)
- 103 **European Parliament.** 2017. European Parliament resolution of 16 May 2017 on initiative on resource efficiency: reducing food waste, improving food safety. European Parliament, Strasbourg, France. https://www.europarl.europa.eu/doceo/document/TA-8-2017-0207_EN.html
- 104 **Council of the European Union.** 2020. Food losses and food waste: assessment of progress made in implementing the Council conclusions adopted on 28 June 2016 – Information from the Presidency and the Commission. Council of the European Union, Brussels, Belgium. 29 pp. https://ec.europa.eu/food/system/files/2021-01/fw_lib_council_food-losses-food-waste_2016_rev-2020.pdf
- 105 **Stenmarck, Å., Jensen, C., Quested, T., Moates, G.** 2016. Estimates of European food waste levels. *Fusions*. The European Community. 80 pp. <http://www.eu-fusions.org/phocadownload/Publications/Estimates%20of%20European%20food%20waste%20levels.pdf>
- 106 **European Food Banks Federation.** 2020. *European Food Banks Federation Annual Report 2019*. European Food Banks Federation, Brussels, Belgium. 24 pp. [Cited 9 August 2021]. <https://www.eurofoodbank.org/en/position-papers>; Annual report (2019) Available at: https://lp.eurofoodbank.org/wp-content/uploads/2020/06/FEBA_2019_Annual_Report_FINAL.pdf
- 107 **Lipinski, B.** 2020. *SDG target 12.3 on food loss and waste: 2020 progress report. An annual update on behalf of Champions 12.3*. Champions 12.3. <https://champions123.org/sites/default/files/2020-09/champions-12-3-2020-progress-report.pdf>
- 108 **Bucataru, C.** 2020. Challenges and initiatives in reducing food losses and waste in Europe. In Yahia, E. M., ed. *Preventing food losses and waste to achieve food security and sustainability*, pp. 653-692. Burleigh Dodds Science Publishing Limited. https://www.researchgate.net/publication/340400578_Challenges_and_initiatives_in_reducing_food_loss_and_waste_in_Europe

- 109 **UNECE.** 2019. *Code of Good Practice: Reducing food loss in handling fruit and vegetables*. [Cited 9 August 2021]. <https://unece.org/sites/default/files/2021-03/CodeOfGoodPractice.pdf>
- 110 **FAO.** 2020. FAO Regional Office for Europe and Central Asia – Central Asia, Azerbaijan and Turkey establish joint Food Loss and Waste Strategy Committee. Text by Sapiga, O. In: *Food and Agriculture Organization of the United States* [Online]. <http://www.fao.org/europe/news/detail-news/en/c/1333202/>
- 111 **Carey, J., & Cook, B.** 2021. *The Milan Urban Food Policy Pact monitoring framework: A practical handbook for implementation*. FAO. Rome. <https://www.milanurbanfoodpolicypact.org/wp-content/uploads/2019/11/CA6144EN.pdf>
- 112 **Fabi, C. & English, A.** 2018. *Methodological proposal for monitoring SDG target 12.3. The global food loss index design, data collection methods and challenges*. FAO, Rome, Italy. [Cited 18 October 2019]. <http://www.fao.org/3/CA2640EN/ca2640en.pdf>
- 113 **Bucatariu, C.** 2020. Challenges and initiatives in reducing food losses and waste in Europe. In Yahia, E. M., ed. *Preventing food losses and waste to achieve food security and sustainability*, pp. 653-692. Burleigh Dodds Science Publishing Limited. https://www.researchgate.net/publication/340400578_Challenges_and_initiatives_in_reducing_food_loss_and_waste_in_Europe
- 114 **Mhlanga, N., Seidler, E., Njie, D., Gallat, S., Lamb, J., Morgan, N., Zorya, S. & Diaz Rios, L.** 2010. *FAO/World Bank workshop on reducing post-harvest losses in grain supply chains in Africa Lessons learned and practical guidelines*. FAO, Rome. 120 pp. <http://www.fao.org/3/a-au092e.pdf>
- 115 **Zorya, S., Morgan, N., Diaz Rios, L., Hodges, R., Bennett, B., Stathers, T., Mwebaze, P. & Lamb, J.** 2011. *Missing Food: The Case of Postharvest Grain Losses in Sub-Saharan Africa*. The World Bank. <https://www.fao.org/sustainable-food-value-chains/library/details/en/c/266345/>
- 116 **World Resources Institute.** 2019. RELEASE: Major Food Retailers & Providers, Rice Industry Announce New Food Loss and Waste Efforts. In: *World Resources Institute* [Online]. Washington, DC. <https://www.wri.org/news/2019/09/release-major-food-retailers-providers-rice-industry-announce-new-food-loss-and-waste>
- 117 **World Bank.** 2019. World Bank and Folksam Group Join Global Call to Action on Food Loss and Waste. In: *The World Bank* [Online]. <https://www.worldbank.org/en/news/press-release/2019/03/20/world-bank-and-folksam-group-join-global-call-to-action-on-food-loss-and-waste>
- 118 **Mhlanga, N., Seidler, E., Njie, D., Gallat, S., Lamb, J., Morgan, N., Zorya, S. & Diaz Rios, L.** 2010. *FAO/World Bank workshop on reducing post-harvest losses in grain supply chains in Africa Lessons learned and practical guidelines*. FAO, Rome. 120 pp. <http://www.fao.org/3/a-au092e.pdf>
- 119 See: <https://www.kbc.co.ke/world-bank-ksh288m-post-harvest/>
- 120 **World Bank.** 2020. *Addressing Food Loss and Waste: A Global Problem with Local Solutions*. Washington, DC, World Bank. 128 pp. (also available at <https://openknowledge.worldbank.org/bitstream/handle/10986/34521/Addressing-Food-Loss-and-Waste-A-Global-Problem-with-Local-Solutions.pdf?sequence=1&is>)
- 121 **World Bank.** 2020. *Grain Storage and Information for Agricultural Competitiveness*. In: *The World Bank* [Online]. <https://projects.worldbank.org/en/projects-operations/project-detail/P160570?lang=en>
- 122 Ibid.
- 123 **Maistry, S.** 2010. AfDB Delegation Makes Key Presentation at the High Level Conference in Abuja. In: *African Development Bank Group* [Online]. <https://www.afdb.org/en/news-and-events/afdb-delegation-makes-key-presentation-at-the-high-level-conference-in-abuja-6406>
- 124 **IFAD.** 2020. Towards zero food waste in Indonesia's fishing communities. In: *IFAD* [Online]. <https://www.ifad.org/en/web/latest/story/asset/42101743>
- 125 **EBRD.** 2019. Promoting Sustainable Practices in Food Retail. In: *European Bank for Reconstruction and Development* [Online]. <https://www.ebrd.com/what-we-do/sectors/legal-reform/sustainable-food-retail.html>
- 126 **HLPE.** 2017. *Nutrition and food systems: A report by the High Level Panel of Experts on Food Security and Nutrition, September 2017*. Rome. [Cited 16 November 2020]. <http://www.fao.org/3/a-i7846e.pdf>
- 127 **The Rockefeller Foundation.** 2020. YieldWise – A World Without Food Waste. In: *The Rockefeller Foundation* [Online]. <https://www.rockefellerfoundation.org/initiative/yieldwise/>
- 128 **FAO.** 2020. FAO and Rabobank's new partnership focuses on helping make food systems more sustainable, including through innovative investments. In: *Food and Agriculture Organization of the United Nations* [Online]. <http://www.fao.org/news/story/en/item/1296715/icode/>
- 129 **Crawford, E.** 2020. Rabobank's FoodBytes! winners offer solutions for food waste, climate change and improved health. In: *FoodNavigator-USA* [Online]. <https://www.foodnavigator-usa.com/Article/2020/12/04/Rabobank-s-FoodBytes!-winners-offer-solutions-for-food-waste-climate-change-and-improved-health>

- 130 **Winnow Solutions, Ltd.** 7 Trends That Impact Everything Food and Beverage in 2020. Winnow Solutions, Ltd. <https://info.winnowsolutions.com/food-and-beverage-trends-2020>
- 131 **Solar Impulse Foundation.** 2019. Winnow: Food waste reduction by connecting commercial kitchens to the cloud. In: *Solar Impulse Foundation* [Online]. Solar Impulse Foundation. <https://solarimpulse.com/efficient-solutions/winnow>
- 132 **Solar Impulse Foundation.** 2022. Solutions to fight Climate Change – Boosting Efficient Solutions: Clean & Profitable. In: *Solar Impulse Foundation* [Online]. Solar Impulse Foundation. <https://solarimpulse.com/efficient-solutions/fit-food-waste-monitoring-tech#>
- 133 **Harvard Law School Food Law and Policy Clinic & Global FoodBanking Network.** 2019. The Global Food Donation Policy Atlas. In: *Center for Health Law and Policy Innovation – Harvard Law School* [Online]. <https://chlpi.org/project/global-food-waste-policy/>
- 134 **Min, H.** 2015. Local NGO sets up first food bank in the city. *Shanghai Daily*, 10 June 2015. [Cited 1 October 2018]. <https://archive.shine.cn/metro/society/Local-NGO-sets-up-first-food-bank-in-the-city/shdaily.shtml>
- 135 **Global FoodBanking Network.** 2015. Newsletters – 10 Things You Should Know about GFN's New Member Food Bank in Shanghai. In: *The Global FoodBanking Network* [Online]. [Cited 1 October 2018]. <https://www.foodbanking.org/10-things-you-should-know-about-gfns-new-member-food-bank-in-shanghai/>
- 136 **Global FoodBanking Network.** 2018. Press Releases – The Global FoodBanking Network Welcomes its First Member from Mainland China. In: *The Global FoodBanking Network* [Online]. [Cited 1 October 2018]. <https://www.foodbanking.org/the-global-foodbanking-network-welcomes-its-first-member-from-mainland-china/>
- 137 **IISD.** 2016. GFFA 2016 Highlights Agriculture and Food Security for SDGs, Climate. In: *IISD SDG Knowledge Hub* [Online]. <http://sdg.iisd.org/news/gffa-2016-highlights-agriculture-and-food-security-for-sdgs-climate/>
- 138 **Global Forum for Food and Agriculture (GFFA).** 2016. How to feed our cities? – *Agriculture and rural areas in an area of urbanization*. Berlin, GFFA and German Federal Ministry of Food and Agriculture. https://www.gffa-berlin.de/wp-content/uploads/2015/10/GFFA_Kommunique_2016_EN.pdf
- 139 **Kitinoja, L., Tokala, V.Y. & Brondy, A.** 2018. Challenges and opportunities for improved postharvest loss measurements in plant-based food crops. *Journal of Postharvest Technology*. 6(4):16–34.
- 140 **Hanson, C. & Mitchell, P.** 2017. *The Business Case for Reducing Food Loss and Waste*. Washington, DC, Champions 12.3. [Cited 9 November 2020]. <https://champions123.org/sites/default/files/2020-08/business-case-for-reducing-food-loss-and-waste.pdf>
- 141 **International Food Waste Coalition (IFWC).** 2022. *International Food Waste Coalition* [online]. Ixelles, Belgium. <http://internationalfoodwastecoalition.org/>
- 142 **International Food Waste Coalition (IFWC).** 2018. *SKOOL 2018: School Kitchen Organisation Optimisation Learning*. IFWC, Ixelles, Belgium. https://internationalfoodwastecoalition.org/wp-content/uploads/2021/01/IFWC_SKOOL_Report_2018.pdf
- 143 **Ekman, J.** 2019. *Final Report: Improved postharvest management of fruit and vegetables in the Southern Philippines and Australia*. Canberra, Australian Centre for International Agricultural Research (ACIAR). https://www.aciar.gov.au/sites/default/files/project-page-docs/final_report_hort-2012-098.pdf
- 144 **United Nations ESCAP.** 2020. *Asia and the Pacific SDG Progress Report 2020*. United Nations Economic and Social Commission for Asia and the Pacific (ESCAP). [Cited 12 December 2020]. https://www.unescap.org/sites/default/files/publications/ESCAP_Asia_and_the_Pacific_SDG_Progress_Report_2020.pdf
- 145 **FAO.** 2020. *Food Loss and Waste Measurement Linked to the Food Loss Analysis Methodology*. FAO. [Cited 2 October 2020]. <http://www.fao.org/3/nc079en/nc079en.pdf>
- 146 **FAO.** 2020. *Report: Thirty-fifth Session of the FAO Regional Conference for Asia and the Pacific*. FAO. 26 pp. [Consulted on 5 November 2020]. (also available at <http://www.fao.org/3/nd688en/nd688en.pdf>)
- 147 **FAO.** 2019. *The State of Food and Agriculture 2019: Moving forward on food loss and waste reduction*. Rome, FAO. 182 pp. (also available at <https://www.fao.org/3/ca6030en/ca6030en.pdf>)
- 148 **Rutten, M., Verma, M., Mhlanga, N. & Bucatariu, C.** 2015. *Potential impacts on sub-Saharan Africa of reducing food loss and waste in the European Union – A focus on food prices and price transmission effects*. Rome, Italy, FAO, LEI Wageningen.
- 149 **Hanson, C. & Mitchell, P.** 2017. *The Business Case for Reducing Food Loss and Waste*. Washington, DC, Champions 12.3. [Cited 9 November 2020]. <https://champions123.org/sites/default/files/2020-08/business-case-for-reducing-food-loss-and-waste.pdf>
- 150 **FAO.** 2013. *Food Wastage Footprint: Impacts on Natural Resources*. FAO, Rome, Italy.

- 151 **Galford, G.L., Peña, O., Sullivan, A.K., Nash, J., Gurwick, N., Pirolli, G., Richards, M., White, J. & Wollenberg, E.** 2020. Agricultural development addresses food loss and waste while reducing greenhouse gas emissions. *Science of The Total Environment*, 699: 134318. <https://doi.org/10.1016/j.scitotenv.2019.134318>
- 152 **Nash, J., Peña, O., Galford, G., Gurwick, N., Pirolli, G., White, J., Wollenberg, E.** 2017. *Reducing food loss in agricultural development projects through value chain efficiency*. CCAFS Working Paper no. 204. Wageningen, The Netherlands, CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). www.ccafs.cgiar.org and <https://www.sciencedirect.com/science/article/pii/S0048969719343098#f0015>
- 153 **APEC.** 2018. *APEC Survey Report on Feasible Solutions for Food Loss and Waste Reduction*. Singapore, APEC Secretariat.
- 154 **Post-harvest losses in ASEAN countries**, FAO, 2008.
- 155 **The ASEAN Secretariat.** *Initiative for ASEAN Integration (IAI) Work Plan III*. Jakarta, The ASEAN Secretariat. <http://aadcp2.org/wp-content/uploads/09rev2Content-IAI-Work-Plan-III.pdf>
- 156 **ASEAN Australia Development Cooperation Program (AADCP).** 2018. *Terms of Reference for Assessment of post-harvest losses and post-harvest loss reduction technologies and practices for a seasonal fruit with high export value and/or export potential in Cambodia, Lao PDR, Myanmar, Viet Nam (CLMV) countries*. AADCP. <https://asean.org/wp-content/uploads/2018/05/TOR-Assessment-of-the-post-harvest-losses-and-post-harvest-loss-reduction-technologies-and-practices-in-CLMV.pdf>
- 157 **Liu, G., Liu, X. & Cheng, S.** 2013. *Food security: Curb China's rising food wastage*. *Nature*, 498(170). <http://www.nature.com/nature/journal/v498/n7453/full/498170c.html>
- 158 **Wu, N.** 2018. Analysis of China's food security situation and coping strategies. Shopping mall modernization. (3): 17-18.
- 159 **The State Council Information Office of the People's Republic of China.** 2019. *Food Security in China*. The State Council Information Office of the People's Republic of China. <http://www.scio.gov.cn/zfbps/32832/Document/1666228/1666228.htm>
- 160 **Liu, G., Liu, X. & Cheng, S.** 2013. *Food security: Curb China's rising food wastage*. *Nature*, 498(170). <http://www.nature.com/nature/journal/v498/n7453/full/498170c.html>
- 161 **Ministry of Foreign Affairs of the People's Republic of China.** 2019. *China's Progress Report on Implementation of the 2030 Agenda for Sustainable Development*. Ministry of Foreign Affairs of the People's Republic of China. https://www.fmprc.gov.cn/mfa_eng/topics_665678/2030kcxzyc/201909/P020210525474868189879.pdf
- 162 **Liu, G.** 2014. *Food Losses and Food Waste in China: A First Estimate*. OECD Food, Agriculture and Fisheries Papers, No. 66. OECD Publishing. <http://dx.doi.org/10.1787/5jz5sq51731q-en>
- 163 **Koetse, M.** 2020. Clean Your Plate, Waste No Food – China's Anti Food Waste Campaign Is Sweeping the Nation. *What's On Weibo*, 21 August 2020. (also available at <https://www.whatsonweibo.com/clean-your-plate-waste-no-food-chinas-anti-food-waste-campaign-is-sweeping-the-nation/>)
- 164 **Chinese Academy of Sciences.** 2017. Liu, J., ed. Research Progress – China Must Cut Its Wasteful Ways. In: *Chinese Academy of Sciences* [online]. [Cited 1 October 2021]. http://english.cas.cn/newsroom/archive/research_archive/rp2017/201702/t20170203_173783.shtml
- 165 **Gu, W.** 2014. Beijing's Corruption Crackdown is a Boon for Bargain-Hunting Chinese. *Wall Street Journal*, 16 January 2014. [Cited 1 October 2018]. (also available at <https://www.wsj.com/articles/no-headline-available-1389868562>)
- 166 **Magstad, M. K.** 2013. No-waste lunch: China's "Clean Your Plate" campaign. *The World*, 22 July 2013. [Cited 1 October 2018]. <https://www.pri.org/stories/2013-07-22/no-waste-lunch-chinas-clean-your-plate-campaign>
- 167 **Australian Government.** 2022. Tackling Australia's food waste: Why we need to reduce food waste. In: *Australian Government Department of Agriculture, Water and the Environment* [online]. <https://www.environment.gov.au/protection/waste/food-waste>
- 168 **Australian Government.** 2020. Joint Media Release: New body to cut Australia's food waste in half. Text by Ley, S. & Evans, T. In: *Australian Government Department of Agriculture, Water and the Environment* [online]. Available at: <https://minister.awe.gov.au/evans/media-releases/new-body-cut-australias-food-waste-half>
- 169 **Fight Food Waste Cooperative Research Centre.** 2018. *Fight Food Waste Cooperative Research Centre* [online]. <https://fightfoodwastecrc.com.au/>
- 170 **SWITCH-Asia.** 2017. *The Sustainable Consumption and Production Roadmap 2017-2036*. Royal Thai Government Sub-Committee for SDG 12. <https://www.switch-asia.eu/resource/thailand-scp-roadmap-2017-2036-en/>
- 171 **Bhattarai, D. R.** 2018. Postharvest horticulture in Nepal. *Horticulture International Journal*. 2(6):458-460. <https://medcraveonline.com/HIJ/postharvest-horticulture-in-nepal.html>

- 172 **FAO.** 2019. SAVE FOOD: Global Initiative on Food Loss and Waste Reduction – Reduction of post-harvest losses in Horticultural chains in SAARC Countries. In: *FAO* [online].
<https://www.fao.org/save-food/projects/saarc-countries/en/>
- 173 **Global Agriculture and Food Security Project (GAFSP).** Nepal Agriculture and Food Security Project (AFSP). In: *GAFSP* [online]. <https://www.gafspfund.org/projects/nepal-agriculture-and-food-security-project-afsp>
- 174 **FAO.** 2020. *Highlights of Technical Assistance to Food and Nutrition Security Enhancement Project (FANSEP)*. Kathmandu, FAO.
- 175 **Global Agriculture and Food Security Project (GAFSP).** Food and Nutrition Security Enhancement Project (FANSEP). In: *GAFSP* [online].
<https://www.gafspfund.org/projects/food-and-nutrition-security-enhancement-project-fansep>
- 176 **Wibowo, S., Utomo, B.S.B., Ward, A.R., Diei-Ouadi, Y., Siar, S. & Suuronen, P.** 2017. *Case studies on fish loss assessment of small-scale fisheries in Indonesia*. FAO Fisheries and Aquaculture Circular No. 1129. Rome, FAO.
<https://www.fao.org/responsible-fishing/resources/detail/en/c/1379063/>
- 177 **Diei-Ouadi, Y. & Mgawe, Y. I.** 2011. *Post-harvest fish loss assessment in small-scale fisheries: A guide for the extension officer*. FAO Fisheries and Aquaculture Technical Paper No. 559. Rome, FAO.
<https://www.fao.org/3/i2241e/i2241e.pdf>
- 178 **GIZ Thailand Agriculture and Food Cluster.** ASEAN Integrated Food Security (AIFS) Framework and Strategic Plan of Action on Food Security in the ASEAN Region (SPA-FS) 2015-2020. https://asean-agrifood.org/?wpfb_dl=58
- 179 **Grow Asia.** 2022. *The ASEAN Guidelines to Promote Responsible Investment in Food, Agriculture and Forestry* [online]. Singapore. <https://www.aseanraiguilines.org/>
- 180 **ASEAN Technical Working Group on Agriculture and Research Development (ATWGARD).** 2018. *The ASEAN Guidelines on Promoting Responsible Investment in Food, Agriculture and Forestry*. ASEAN.
<https://asean.org/storage/2012/05/ASEAN-Guidelines-on-responsible-investment-in-FAF.pdf>
- 181 **Arneth, A., Barbosa, H., Benton, T.G., Calvin, K., Calvo, E., Connors, S., Cowie, A., et al.** 2019. *Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems – Summary for Policymakers*. The Intergovernmental Panel on Climate Change (IPCC).
https://www.ipcc.ch/site/assets/uploads/sites/4/2020/02/SPM_Updated-Jan20.pdf
- 182 **FAO.** 2013. *Food wastage footprint: Impacts on natural resources - Summary Report*. Rome, FAO.
- 183 Ibid.
- 184 **FAO.** 2014. *Mitigation of Food Wastage Societal Costs and Benefits*. Rome, FAO.
- 185 **FAO.** 2013. *Toolkit – Reducing the Food Wastage Footprint*. Rome, FAO.
- 186 **Southeast Asian Regional Centre for Graduate Studies and Research in Agriculture (SEARCA).** 2022. *SEAMEO SEARCA: Southeast Asian Regional Center for Graduate Study and Research in Agriculture* [online].
<https://www.searca.org/>
- 187 **Scialabba, N.** 2015. *Food wastage footprint & Climate Change*. FAO.
<https://www.fao.org/documents/card/en/c/7338e109-45e8-42da-92f3-ceb8d92002b0/>
- 188 **Modak, P., Pariatamby, A., Seadon, J., Bhada-Tata, P., Borongan, G., Thawn, N.S. & Lim, M.B.** 2017. *Asia Waste Management Outlook*. United Nations Environment Programme (UNEP).
<https://www.unep.org/ietc/resources/publication/asia-waste-management-outlook>
- 189 **Le Roux, B., Van der Laan, M., Vahrmeijer, T., Annandale, J.G. & Bristow, K.L.** 2018. Water footprints of vegetable crop wastage along the supply chain in Gauteng, South Africa. *Water*, 10(5):539.
- 190 **Project Drawdown.** 2019. Sector Summary: Food, Agriculture, and Land Use. In: *Project Drawdown* [online].
<https://www.drawdown.org/solutions/food>
- 191 **Crumpler, K., Dasgupta, S., Federici, S., Meybeck, M., Bloise, M., Slivinska, V., Salvatore, M. et al.** 2020. *Regional analysis of the nationally determined contributions in Asia – Gaps and opportunities in the agriculture and land use sectors*. Environment and Natural Resources Management Working Paper No. 78. Rome, FAO.
<https://doi.org/10.4060/ca7264en>
- 192 **HLPE.** 2014. *Food losses and waste in the context of sustainable food systems*. Rome, FAO. (also available at <https://www.fao.org/3/i3901e/i3901e.pdf>)
- 193 **Peñarubia, O.** 2020. Renewable Energy and Reducing Food Loss and Waste in Fish Value Chains. *FAO*, 26 October 2020. <http://www.fao.org/flw-in-fish-value-chains/resources/articles/Renewable-Energy-and-Reducing-Food-Loss-and-Waste-in-Fish-Value-Chains/en/>

- ¹⁹⁴ **Nash, J., Peña, O., Galford, G., Gurwick, N., Pirolli, G., White, J., Wollenberg, E.** 2017. *Reducing food loss in agricultural development projects through value chain efficiency*. CCAFS Working Paper no. 204. Wageningen, The Netherlands, CGIAR Research Program on Climate Change, Agriculture and Food Security (CAAFS). Available online at: www.ccafs.cgiar.org
- 195 **The James Dyson Award.** 2020. National Runner Up – Barcodiscount. In: *The James Dyson Award* [online]. <https://www.jamesdysonaward.org/2020/project/barcodiscount/>
- 196 **FAO.** 2020. *Food Loss and Waste Measurement Linked to the Food Loss Analysis Methodology*. [Cited 2 October 2020]. <http://www.fao.org/3/nc079en/nc079en.pdf>
- 197 **United Nations Environment Programme & Climate and Clean Air Coalition.** 2021. *Global Methane Assessment: Benefits and Costs of Mitigating Methane Emissions*. Nairobi, United Nations Environment Programme. <https://www.unep.org/resources/report/global-methane-assessment-benefits-and-costs-mitigating-methane-emissions>
- 198 **FAO.** 2019. *The State of Food and Agriculture 2019: Moving forward on food loss and waste reduction*. Rome, FAO. 182 pp. (also available at <https://www.fao.org/3/ca6030en/ca6030en.pdf>)
- 199 **UNEP.** 2021. *Food Waste Index Report 2021*. Nairobi, United Nations Environment Programme. <https://www.unep.org/resources/report/unep-food-waste-index-report-2021>
- 200 **United Nations Environment Programme & Climate and Clean Air Coalition.** 2021. *Global Methane Assessment: Benefits and Costs of Mitigating Methane Emissions*. Nairobi, United Nations Environment Programme. <https://www.unep.org/resources/report/global-methane-assessment-benefits-and-costs-mitigating-methane-emissions>
- 201 **Asian Development Bank (ADB) & International Food Policy Research Institute (IFPRI).** 2019. *Ending hunger in Asia and the Pacific by 2030: An assessment of investment requirements in agriculture*. Mandaluyong City, Philippines, ADB, IFPRI. <https://www.adb.org/sites/default/files/publication/533281/ending-hunger-asia-pacific-2030.pdf>
- 202 **FAO.** 2020. *Food Loss and Waste Measurement Linked to the Food Loss Analysis Methodology*. [Cited 2 October 2020]. <http://www.fao.org/3/nc079en/nc079en.pdf>
- 203 **FAO.** 2020. *Guidelines on the measurement of harvest and post-harvest losses – Findings from the field test on estimating harvest and postharvest losses of fruits and vegetables in Mexico. Field test report*. Rome, FAO. <https://www.fao.org/3/cb1511en/CB1511EN.pdf>
- 204 **FAO.** 2016. *Food Loss Analysis: Causes and Solutions. Case studies in the Small-scale Agriculture and Fisheries Subsectors: Methodology*. Rome, FAO. <https://www.fao.org/3/az568e/az568e.pdf>

FAO Regional Office for Asia and the Pacific

FAO-RAP@fao.org
www.fao.org/asiapacific/

Food and Agriculture Organization of the United Nations
Bangkok, Thailand

ISBN 978-92-5-135884-9



9 789251 358849

CB8959EN/1/07 22