



Food and Agriculture
Organization of the
United Nations



International Water
Management Institute

Governance analysis for urban wholesale to household's food waste prevention and reduction in Sri Lanka



RESEARCH
PROGRAM ON
Water, Land and
Ecosystems

Governance analysis for urban wholesale to household's food waste prevention and reduction in Sri Lanka

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Food and Agriculture Organization of the United Nations

International Water Management Institute

Colombo, 2023

Required citation:

Aheeyar, M. Jayathilake, N., Bucatariu, C. Reitemeier, M., Bandara, A., Thiel, F. and Drechsel, P. 2023. *Governance analysis for urban wholesale to household's food waste prevention and reduction in Sri Lanka*. Colombo, FAO and IWMI.
<https://doi.org/10.4060/cc0174en>

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ISBN 978-92-5-136247-1 [FAO]

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Contents

Acknowledgements.....	iv
Abbreviations and acronyms	v
Executive summary	vi
1. Introduction	1
2. Overview of the governance framework.....	1
2.1 Food and nutrition	5
2.2 Climate change.....	6
2.3 (Bio-)waste management.....	7
2.4 Provincial policies and regulations.....	17
2.5 Non-state measures.....	18
2.6 Gaps	19
3. Conclusions and recommendations.....	20
4. References	22

Figures

Figure 1. Innovative approaches to reduce, recycle and reuse food waste in urban Sri Lanka (2019-2021) project structure	1
Figure 2. The conceptual framework for FLW (FAO, 2019)	2
Figure 3. Connectivity of regulatory agencies of the central government and provincial administration – for food waste prevention, reduction and management in Sri Lanka	4

Tables

Table 1. Major governance tools linked with food waste prevention, reduction and management	8
Table 2. Governance analysis matrix for food waste prevention and reduction in Sri Lanka	16

Annexes

Annex 1. Legislative and policy framework related to food production	25
Annex 2. By-laws on food security and related aspects of Colombo municipal Council.....	26
Annex 3. A selection of international non-state food waste prevention and reduction initiatives.....	28
Annex 4. European Union examples of governance for food waste prevention and reduction.....	30
Annex 5. A selection of national policies on animal feed.....	32

Acknowledgements

The authors wish to acknowledge the contributions made by all the stakeholders at various discussions in addition to sharing data and information. Support provided by International Water Management Institute (IWMI) research intern Saumya Amarakoon is highly appreciated. This report is delivered under the project on “Innovative approaches to reduce, recycle and reuse food waste in urban Sri Lanka” that was implemented under the oversight of the Ministry of Urban Development and Housing in collaboration with the Food and Agriculture Organization of the United Nations (FAO) and the International Water Management Institute (IWMI) from June 2019 to August 2021. Thanks also go to CGIAR Research Program on Water, Land and Ecosystems (WLE).

Abbreviations and acronyms

CEA	Central Environmental Authority
EPL	environmental protection licence
FAO	Food and Agricultural Organization of the United Nations
FLW	food loss and waste
FW	food waste
HACCP	Hazard Analysis Critical Control Point
IWMI	International Water Management Institute
LAs	local authorities
MBM	meat and bone meal
MSW	municipal solid waste
NEA	National environmental act
NPSWM	National policy for solid waste management
PC	provincial council
RRR	reduce, recycle and reuse
SCP	sustainable consumption and production
SDG	Sustainable Development Goal
SWM	solid waste management
UDA	Urban Development Authority
WMU	waste management unit

Executive summary

Sri Lanka generates around 7 000 tonnes of solid waste per day. From the total solid waste generated, approximately 65–66 percent, by weight, is organic waste. The proportion of food waste (FW) generated in a local authority (LA) area range from 50–69 percent of the total waste with an average of 56.56 percent. According to this average value, the estimated total FW generated in the country is around 3 955 tonnes per day. The country faces many challenges in tackling the FW issue due to gaps in governance.

Governance analysis allows a comprehensive understanding of state and non-state challenges and solutions towards FW prevention and reduction. Currently, the governance framework for food safety and quality and (bio-)waste management is under the umbrella of the central government, provincial council (PC) and local authorities (LAs). Additionally, several central and provincial government agencies perform tasks related to (bio-)waste management. Under the 13th amendment made to the constitution of 1987, LAs are under the purview of PCs. The PCs are responsible to help and guide the LAs in the execution of waste and sanitation-related activities. The PCs are empowered to make all decisions on capacity building, resource allocation, adoption of provincial-level policies and establishing appropriate institutional arrangements to handle the delegated tasks of waste management.

The regulatory tools dealing with food and bio-waste management cut across different stages of waste management without directly addressing FW reduction except through composting and separation of recyclables to minimize volumes going to landfill sites. Socioeconomic and environmental business-oriented innovations are needed to drive the change from bio-waste management to prevention of FW through education, civil society support and private sector involvement. The existing regulatory system requires the introduction of law enforcement mechanisms for the effective implementation of legal provisions. Pilots on segregation of biodegradable waste at household level have taken place in several LAs. Comprehensive by-laws that promote FW prevention, reduction, reuse, and recycling are yet to be implemented. However, the National policy and strategy on cleaner production for agriculture and fisheries sectors, the sustainable consumption and production policy of 2019, the overarching agricultural policy (2020–2025) and National Agricultural Policy of 2021 cover the entire food value chain and include FW reduction.

Regulations need to focus on socioeconomic incentives as well as tools for facilitating behavior change for supply chain actors and consumers. Socioeconomic and environmental innovative solutions are needed to drive the change from bio-waste management to prevention of FW. Solutions should include education for food literacy for all age groups, enabled civil society collaboration/support, and private sector informed involvement. Establishing linkages with various national and local ongoing state and non-state working groups on food, nutrition, waste, health, education and climate change could be effective in introducing measures on FW. Finally, sufficient budgetary allocation should allow multi-disciplinary awareness-raising campaigns that can be linked with ongoing actions on, for instance, climate change and nutrition.

Capacities of LAs should be strengthened for ensuring food safety and hygiene through technical expertise and laboratory facilities. State actors should create an enabling environment for the private sector organizations to adopt measures for FW prevention and reduction through platforms that enable good practices and evidence exchanges. Currently, several business entities have adopted self-

regulation and voluntary standards to reduce FW and invested in reuse and recycling practices due to ethical and environmental concerns as well as economic benefits.

LAs by-laws could provide socioeconomic incentives and enforce reduction mechanisms such as FW measurement and reporting by food business operators and/or introduce penalties for certain FW thresholds. Moreover, LAs could implement capacity development programs on sanitary inspections and quality assurance for small-scale food establishments. Legal and operational guidance on FW prevention for wholesalers, supermarkets, retail outlets and restaurants through redistribution of safe and nutritious food for direct human consumption should facilitate adoption and scale-up for this solution.

The report was produced for the project “Innovative approaches to reduce, recycle and reuse FW in urban Sri Lanka.” The project was implemented under the oversight of the Ministry of Urban Development and Housing, in collaboration with the Food and Agriculture Organization of the United Nations (FAO) and the International Water Management Institute (IWMI) from June 2019 to August 2021. The knowledge from the report supported the drafting of the *National Roadmap on Urban Food Waste Prevention and Reduction for Households, Food services, Retailers and Wholesalers* that was launched on 17 August 2021.

1. Introduction

This report explores and analyses the governance framework (that is policies, laws and regulations) relevant to urban food waste (FW) prevention and reduction in the wholesale, retail, hospitality (restaurants, hotels), food services (schools, hospitals) and households in Sri Lanka. The Project “Innovative approaches to reduce, recycle and reuse food waste in urban Sri Lanka” was implemented from June 2019 to August 2021 under the oversight of the Ministry of Urban Development and Housing and in collaboration with the Food and Agriculture Organization of the United Nations (FAO) and the International Water Management Institute (IWMI). This report is the project output for activity 1.2 (see **Figure 1**).

Figure 1. Innovative approaches to reduce, recycle and reuse food waste in urban Sri Lanka (2019–2021) project structure



The main objective of the project was to facilitate, through a collaborative effort, the drafting of an *Urban Roadmap and Action Plan on food waste Prevention, Reduction, Management in Sri Lanka* that identifies concrete steps to implement towards achieving Sustainable Development Goal 12.3 (SDG 12.3).

In 2015, the 2030 Agenda launched Sustainable Development Goal (SDG) 12 on ensuring “sustainable consumption and production (SCP) patterns” that includes target 12.3 “by 2030, halve per capita global FW at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses.” The 2020 FAO Conference highlighted that “improving data collection on food losses and FW is a priority for monitoring progress towards achieving the SDGs” (FAO, 2020). Achieving SDG 12.3 may reduce the food systems’ environmental impacts by up to one-sixth (World Bank, 2020).

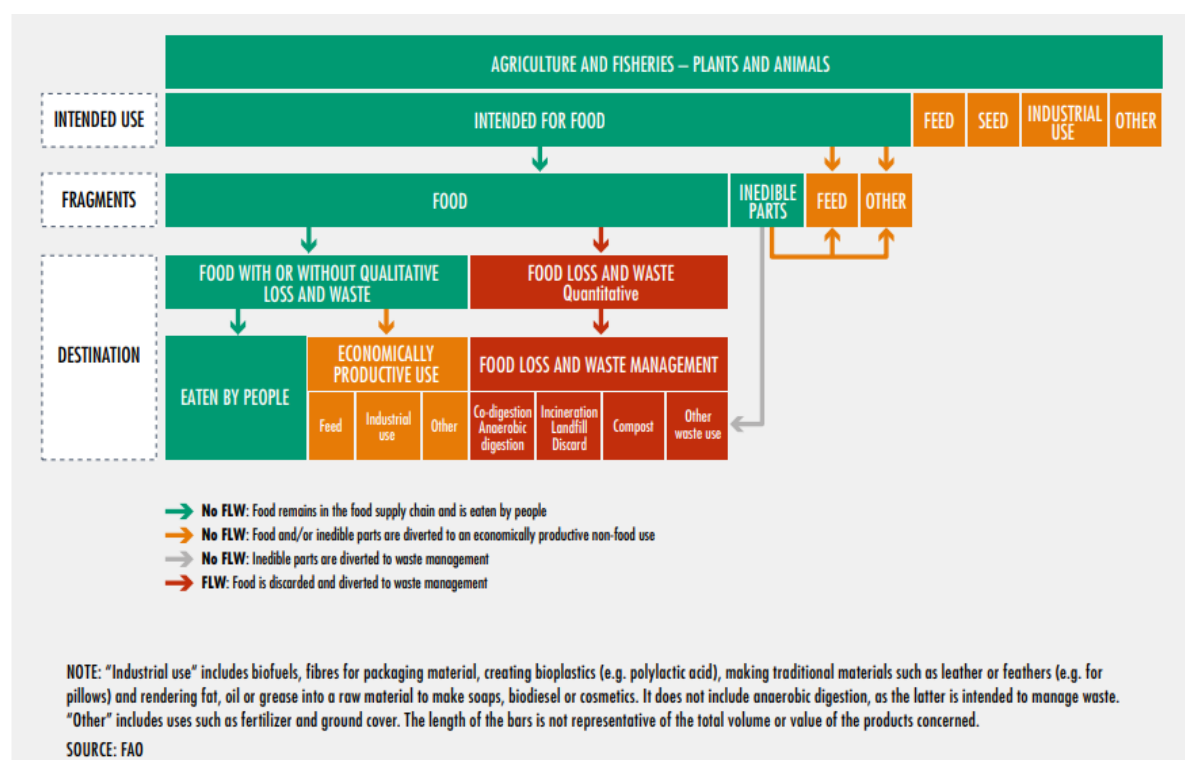
Global food loss and waste (FLW) was estimated to cause between 8 and 10 percent of the emissions of the gases responsible for global warming in the period 2010–2016 (Intergovernmental Panel on Climate Change (IPCC), 2020). SDG 12.3 and the Paris Agreement can develop mutually reinforcing targets and reporting systems at the national level. Specifically, there are opportunities for countries to leverage SDG 12.3 as a contributor to 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) (FAO, 2019).

2. Overview of the governance framework

The FW Index (that is sub-indicator 12.3.1.b) is tracking progress on FW reduction from retail to households (demand-driven) and it is technically supported by FAO and led by the UN Environment. It measures tonnes of wasted food per capita, considering a mixed stream of products from processing to consumption. The operational definition of FW is *food and associated inedible parts removed from the human food supply chain at the following stages of the food chain: manufacturing of food products;*

food retail and wholesale; out-of-home consumption and in-home consumption (UNEP, 2021). Definitions are at the basis of measurement that allows tracking progress towards SDG 12.3 has two components: food loss and FW. Each component is measured by a separate indicator.¹ The overall conceptual framework for FLW is presented in **Figure 2**.

Figure 2. The conceptual framework for FLW



Source: FAO. 2019. *The state of Food and Agriculture. Moving Forward on Food Loss and Waste Reduction*. Rome. 168 pp. (also available at <https://doi.org/10.1002/9780470172506.ch60>).

Sri Lanka produces around 710 000 tonnes of vegetables and 540 000 tonnes of fruits annually (EDB, 2013), but large quantities of perishables are wasted during peak production periods. According to past research findings, total food loss taking place in rice is in the range of 13–23 percent (Prasanna, Gunaratne and Withana, 2004); losses occurred in beans is around 30 percent (Sarananada, 2000); losses in brinjal is 48.7 percent (Jayathunge *et al.*, 2011), quantity loss in fish is 39 percent (Arachch *et al.*, 2000), losses due to banana damages is 18 percent (Wasala *et al.*, 2014) and losses in papaya due to damages is 46 percent of the total production (Sarananda, Balasuriya and Ganeshalingam, 2004). The estimated annual post-harvest losses of fruits in Sri Lanka are 30–40 percent of the production (Central Bank of Sri Lanka, 2010). The post-harvest losses of some local varieties such as local mangoes are approximately 40–60 percent (Gunawardane and Wanninayake, 2018). The amount of losses generated has a direct linkage with the quantities of perishable foods supplied to the wholesale market and at the later stages.

The total amount of solid waste generated by Sri Lanka is around 7 000 tonnes per day. It typically consists of a very high percentage of perishable organic material which is about 65–66 percent by weight (Arachchige *et al.*, 2019; FAO, 2018; Bandara, 2011). It is assumed that nearly half of the

¹ Food loss is defined as 'the percentage of food quantities removed from the supply chain'. The Food Loss Index sub-indicator 12.3.1.a, that is tracking food losses (supply-driven), estimated that 13.8 percent of all food produced in 2016 was lost – estimates in physical quantities for different commodities and aggregated by an economic weight—from the farm up to, but excluding, the segment from retail to households. Asia and the Pacific regional estimates range from 5–6 percent in Australia and New Zealand to 20–21 percent in central and southern Asia (FAO 2019).

biodegradable part of municipal solid waste (MSW) is FW (SLILG, 2008). Thus, the proportion of FW generated in a local authority (LA) range from 50–69 percent of the total waste with an average of 56.5 percent. According to this average value, the total FW generated in the country can be estimated as 3 955 tonnes per day. (FAO and IWMI, 2023).

The estimated amount of FW generated in Colombo municipal council (CMC) was 353 tonnes/day in 2017, which is half of the total waste generated in this geographical area. Waste analysis estimate done for the segregated waste collected by the CMC shows that it primarily consists of household FW, followed by 110 tonnes/day from food services, 25 tonnes/day from markets and 9 tonnes/day from slaughterhouses and meat shops (FAO, IWMI and RUAF, 2018). According to Sandaruwani and Gnanapala (2016), 79 percent of the solid waste generated by the hotels in Colombo is FW. A study conducted in the Eravur Pradeshiya Sabha² area in the Batticaloa district shows that every household generates an average of 2.06 kg of FW per day contributing 79 percent of the total waste generated in the area out of an estimated 20 tonnes of solid waste generated (Thirumarpan *et al.*, 2015).

At the same meantime, about 22 percent of the total population in Sri Lanka do not have sufficient food to sustain a healthy life and 33 percent of the people cannot afford a nutritious diet (WFP, 2020). According to the National Nutrition and Micronutrient Survey of 2012, the prevalence of high levels of acute malnutrition between 14–35 percent across the districts with 19.6 percent of wasting. High levels of acute malnutrition - ranging between 14 and 35 percent were found across all 25 districts surveyed (Jayatissa, Gunathilaka and Fernando, 2012). Sri Lanka is ranked in 66th position in the Global hunger index with a score of 17.1 indicating moderate hunger.³ Therefore, reduction and reuse of FW have a definite role in achieving SDG targets of reducing poverty (SDG 1) and food and nutrition security (SDG 2).

The governance framework set up for food control and (bio-)waste management is under the umbrella of the Central Government, provincial council (PC) and local authority (LA). The major central government agencies that are directly related to laws and administrations waste management are the Ministry of Public Services, Provincial Councils and Local Government, the Ministry of Environment and the Ministry of Urban Development and Housing while the Ministry of Health (MoH), the Ministry of Technology and Research and the Ministry of Trade have a role in managing the FW. Several agencies perform tasks related to (bio-)waste management (see **Figure 3** on p.4). A coherent governance framework (for example, policies, laws, by-laws) could support FW prevention and reduction from wholesale to households while recognizing the contributions to minimize natural resources and climate change impacts derived from FW.

²Local authorities are divided into three different groups: municipal councils, urban councils and divisional councils (Pradeshiya Sabha), the later one is the third-tier local council in the country.

³Available at: <https://www.globalhungerindex.org/pdf/en/2019/Sri-Lanka.pdf>.

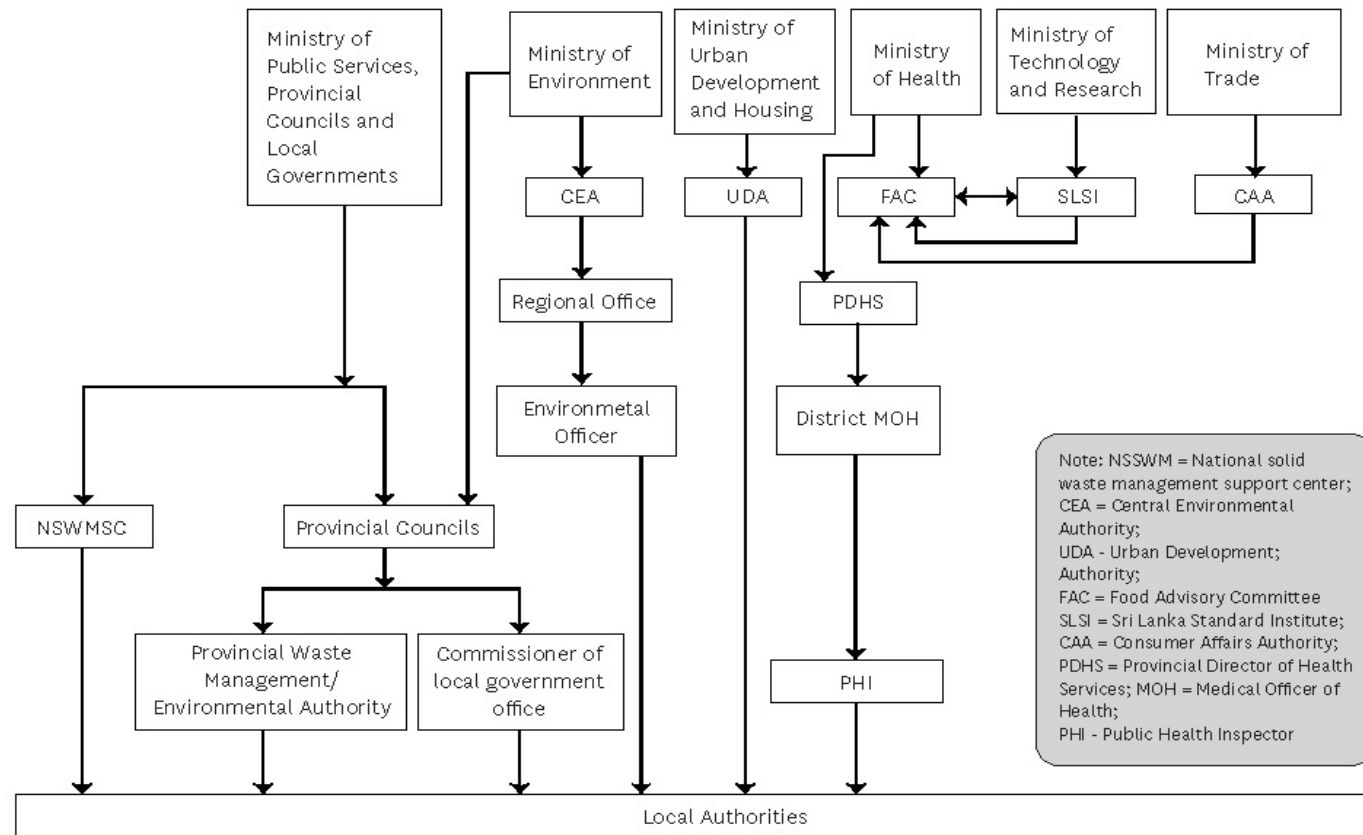


Figure 3. Connectivity of regulatory agencies of the central government and provincial administration – for food waste prevention, reduction and management in Sri Lanka

2.1 Food and nutrition

Sri Lanka's food security policy is covered under the National Agriculture Policy (NAP) of 2021 and the National Nutrition Policy of Sri Lanka of 2010. NAP introduced by the Ministry of Agriculture (MoA) is aiming to achieve national food and nutrition security, increase employment opportunities and income, and the standard of living of the farmers through adopting technically feasible, socially acceptable, economically viable and environmentally sustainable agricultural production technologies and marketing. The National Nutrition Policy provides a platform for inter-sectoral coordination to accelerate efforts to achieve optimum nutrition for the people. The policy also provides overall guidance for the development of national strategic plans of action for nutrition activities. The major policy and regulatory instruments adopted by the government of Sri Lanka to guide the production and service delivery mechanism of the major agricultural products are described in **Annex 1** on P. 25. However, some of the acts are not in practice due to a lack of regulatory enforcement while some of the existing policies should be updated (Ministry of Agriculture, 2019).

The Ministry of Fisheries and Aquatic Resources has adopted a National policy and strategy on cleaner production for fisheries (2008). One of the policy objectives is to prevent and minimize post-harvest losses and improve the quality and safety of fish and aquatic products, in line with European Union (EU) standards (see **Annex 4** on P. 30 for European Union examples on governance linkages for FW prevention and reduction, not only for fisheries). The policy includes the application of proper handling practices, mitigation of over-fishing, promotion of new products based on under-utilized species or fish parts and resources conservation and management.

The MoA's National policy and strategy on cleaner production for the agriculture sector (2012) has the goal of ensuring food and nutrition security via natural resources' eco-efficiency. It also promotes sustainable consumption and production practices through the application of the life cycle approach to reduce overuse/misuse of resources/raw materials and waste generation. Several other policies are in place to guide state interventions on food production, such as National plantation industry policy framework (2006), National livestock policy (2006), National fisheries and aquaculture policy (2018) and National agricultural research policy and strategy 2018–2027 (2018). All these policies are mainly focusing on production and no direct link is provided with FW reduction.

The overarching agricultural policy (2019) has the vision of creating a globally competitive agriculture sector for national prosperity and the objective to enhance the competitiveness of agriculture and agri-businesses through innovative and sustainable technologies and constructive partnerships, in a conducive institutional and regulatory environment, to enhance contribution to economic growth and rising living standards of people engaged in agriculture, while ensuring sustainable use of natural resources and contributing to national food security. One of the thematic areas mentioned in the overarching policy statement is "Adaptation to climate change; minimize loss and damage via increased climate resilience; climate-smart agriculture." However, the major policy thrusts discussed in this theme are limited to mainstreaming climate change through enhancing farmers' resilience through building capacities and adopting suitable coping strategies. There are no direct measures proposed to minimize FW.

Another relevant area mentioned in the policy is the enhancement of availability, affordability, accessibility and stability of food. This section of the policy highlights linkages with FW reduction:

- Post-harvest losses, especially in perishable products.
- Food safety with appropriate responses through the full value chain.
- Storage, processing and other options for value-addition to cater to demand shaped by changing lifestyles and timing of production and demand.
- Introduce and implement appropriate technologies to improve the quality and safety of food.

The Ministry of Agriculture has recently adopted National Agricultural Policy of 2021 that has identified food safety and quality management as one of the thematic areas. The policy has listed several action points to achieve the policy goal that included development and adoption of regulations to ensure food safety in both locally produced and imported food products in consultation and collaboration with the Ministry of Health, establishment of state of the art laboratories to monitor food standards, development of food safety standards, adoption of standard process control measures for food product quality and adoption of a stringent labeling system for food products.⁴

The National Nutrition Policy was adopted by the Ministry of Healthcare and Nutrition issuing the extraordinary gazette No. 1639/5 in 2010. Major activities specified are nutrition education and behavior change programs through organized sessions about the importance of nutrition in relation to dietary diversification, cooking and storage; steps for food safety and facilitating access to adequate, nutritious, safe, and quality foods.

The National sustainable consumption and production policy (Ministry of Environment, 2019) targets minimizing natural resource use and waste and pollutants generated throughout the entire production and consumption process in all economic sectors. The relevant policy goals related to FW reduction are specified in the policy: sustainable management and efficient use of natural resources and a 50 percent reduction of per capita FW at the retail and consumer levels and food losses along production and supply chains, including post-harvest losses. To implement the policy, it has been proposed to establish a National Committee on SCP and an SCP inter-agency expert working group (IAEWG), consisting of representatives of relevant government agencies and non-governmental institutes (private sector, academia, research institutes and consumer organizations), to technically support on request basis the Committee, via specific thematic sub-working groups.

2.2 Climate change

Climate change and food production systems are interrelated. FW is associated with natural resources depletion and climate change, including the emission of harmful gases from landfilling. Sri Lanka has ratified United Nations Framework Convention on Climate Change (UNFCCC) and is obliged to prepare a series of governance instruments (for example, policies) to combat the effect of climate change. The Climate Change Secretariat, that is under the Ministry of Environment (MoE), was entrusted to prepare number of strategic documents that also present connections with FW prevention and reduction. However, these connections are not always identified in the documents.

The second national communication on climate change (2011)⁵ considered four sectors: agriculture, water resources, human health and the coastal sector. The report also describes the generation and disposal of solid waste, industrial effluent and air pollution. The key adaptation options proposed for the agriculture sector are the development of new varieties, changes to the cropping calendar, the introduction of new irrigation technologies, adoption of soil and water conservation measures. The adaptation measures are largely aimed to reduce the crop losses caused by extreme weather conditions and enhance productivity through the introduction of new technologies and efficient use of natural resources.

One of the key strategic thrust areas of the National climate change adaptation strategy 2010–2016 was to minimize climate change impacts on food security through ensuring that food production addresses the nutrition demand and through an increased awareness at the community level on

⁴Available at: https://eysl-rural_development.

⁵ Available at <https://unfccc.int/resource/docs/natc/lkanc2.pdf>.

climate change adaptation. The document listed a number of adaptation measures to minimize the effects of climate change. A direct link with FW minimization, as a means of reducing damaging impacts on the environment, was not indicated.

The overall national climate change policy of Sri Lanka was developed by the Climate Change Secretariat of the Ministry of Environment and adopted in 2012 to provide guidance and directions for all stakeholders while recognizing and promoting the utilization of appropriate traditional knowledge. SCP is among the guiding principles. The adoption of integrated waste management systems while providing priority for the prevention of waste generation with appropriate technologies has been listed as one of the mitigation measures. The policy has also identified the importance of promoting SCP considering the family as the focus to ensure wider dissemination of environment-friendly lifestyles and practices, where FW reduction at the consumer levels has a role to play. The policy also proposes to establish a sound monitoring and reporting system at national, provincial, district and local levels to evaluate the performance of the national climate change policy through developing and strengthening an inter-institutional coordinating, collaborating mechanism.

The 2016–2025 National climate change adaptation plan (NCCAP) is a selection of practical interventions identified by relevant stakeholders to overcome anticipated threats due to the impacts of climate change. It is the country's road map for confronting challenges posed by global climate change and overcoming challenges posed to food security from agriculture, livestock and fisheries. The NCCAP listed its priority actions:

- a) develop tolerant varieties (for example, paddy, horticulture) and breeds (for example livestock and poultry) to heat stress, drought and floods and resistance to diseases and pest attacks;
- b) develop and promote water-efficient farming methods;
- c) adjust cropping calendars according to climate forecasts;
- d) develop systems for timely issuing and communicating of climate information to farmers; and
- e) develop research institute capacity for conducting research on tolerant varieties/breeds and climate-resilient farming methods.

Unfortunately, the action plan has failed to prioritize or identify the importance of addressing the issue of FW to reduce the climate-induced threat on food security.

2.3 (Bio-)waste management

There are several acts, ordinances, policies, adaptation plans and by-laws available to address the issue of overall waste reduction and management. Policies and regulations are not directly addressing FW reduction and FW is not identified as a separate waste stream in (bio-)waste characterization and quantifications. The major acts, ordinances and policies that have a direct and indirect link with waste generation and management are described in **Table 1** on P.8.

Table 1. Major governance tools linked with food waste prevention, reduction and management

Ministry	Policy & Regulation	Description
Acts and ordinances		
Ministry of Public Services, Provincial Councils and Local Government	Urban council ordinance No 61 of 1939	Sections 118, 119 and 120 of the act addresses waste management responsibilities of Urban Councils. Waste generated in the area is the property of the council and should allocate resources for the management. The huge resource requirement encourages the LAs to take action to reduce waste generation to efficiently utilize the councils' scarce financial and human resources. Source segregation is promoted to Reduce, reuse and recycle (RRR) business and reduce the waste going to landfills. Segregation of waste at the household level could provide a volumetric impression of different kinds of waste generated including FW.
	Municipal council ordinance No 16 of 1947	Sections 129,130 and 131 of the act addresses the waste management responsibilities of municipal councils. The responsibilities and incentives to reduce waste are similar to Urban council act.
	Nuisance ordinance No 62 of 1939 and No 57 of 1946	Section 2(3) and 2(12) of the ordinances empowered LAs to prevent and prohibit acts of public nuisance and punish violators for such actions. The act discourages all types of waste generation, indirectly restricting the dumping of waste.
	Pradeshiya sabha act No 15 of 1987	Section 93 and 94 of the act specify the waste management responsibilities of Pradeshiya sabhas. The responsibilities and incentives to reduce waste are similar to Urban council and Municipal council acts.
	Provincial councils act No. 42 of 1987 and amended act No. 56 of 1988	Provide provisions for the LAs for the management of waste. The act provides provisions to allocate resources and provide capacity building and other needed supports to LAs to perform their waste management functions.
Ministry of Defense	Police ordinance No. 16 of 1865	Section 63(g)-prohibits the throwing of any dirt, filth, rubbish, or any stones or building materials in the street, road, canal, or other thoroughfares. If anyone failed, can be taken into custody without a warrant and are liable to a fine or imprisonment. The act discourages waste generation indirectly not allowing haphazard dumping.
Ministry of Health	Food act No. 26 of 1980	<p>The act provides regulations on the following:</p> <ul style="list-style-type: none"> No. 560/13 (Hygiene) No. 615/11 (Preservatives) No. 1646/19 (Formaldehyde in Fish) No. 1660/30 (Packaging materials and articles) No. 1694/5 (Shelf-Life) <p>The act and the provisions ensure safety, keeping quality, appearance and shelf life of the food that would delay spoilage to reduce FW.</p>

	Prevention of mosquitoes breeding act No.11 of 2007	Section 2-Prohibit the creation of conditions favorable to the breeding of mosquitoes including haphazard dumping of waste. Section 4-Failure to comply with requirements imposed is a punishable offense. The Act discourages waste generation by not allowing haphazard dumping.
Ministry of Environment	National environmental act No. 47 of 1980, amended act No 56 of 1988 and amended act No. 53 of 2000	The act provides provisions to establish the Central Environmental Authority (CEA) Section 12 and 26 of the act addresses waste management. Special regulation, No. 1627/19 (2009)-No dumping waste along the roadsides other than the places designated for such purposes.
Ministry Highways	National thoroughfares act No 40 of 2008	Waste management addresses at section 64 (a), (b), (c) and section 65. The haphazard dumping of waste along the highways is prevented by the act.
Policies, strategies, plans, and programs		
Ministry of Environment	National policy of solid waste management	Waste management addresses at; Provide integrated socially responsible solutions for solid waste management (SWM) providing more attention to resource recovery from waste.
	National solid waste management strategy in Sri Lanka	Promotes waste minimization, maximum resource recovery and sanitary landfills. This provides more attention to resource recovery from waste.
	National policy on SCP for Sri Lanka	Promoting zero waste in food systems is one of the objectives. This is supported by a policy goal of achieving 10 percent FW reduction by 2020 and another 20 percent by 2030.
	"Pilisar" national solid waste management program of 2008	National level solid waste management program introducing waste treatment facilities at local authority levels. The policy promotes the recycling of organic waste that consisted major portion is FW.
	Environmental protection licence scheme	Regulatory tool under the Gazette Notification No. 1533/16 dated 25.01.2008 that controls the establishment of RRR business.
Guidelines		
Ministry of Health	Healthcare waste management guideline of 2001	Provide recommendations to manage hospital generated clinical waste with minimum harm to the environment.
Ministry of Public Services, Provincial Councils and Local Government	SWM guideline for LAs of 2003	Guide LAs on the SWM practices
Ministry of Environment	Technical guidelines on MSW management in Sri Lanka of 2005	Support the SWM and siting of engineered landfills

	Technical guidelines on SWM in Sri Lanka of 2007	Support the construction of the engineered landfill
	Guidelines for the management of scheduled waste in Sri Lanka of 2009	Management of scheduled waste.

In 2007, the National policy for solid waste management (NPSWM) was formulated to replace the National strategy for SWM (2000) and it targets minimization, reuse, recycling and appropriate final disposal. The policy was prepared based on the “polluter pays” principle to ensure integrated, economically feasible and environmentally sound and socially responsible practices for the country at the national, provincial and LA levels.

The policy has a decentralized responsibility of waste management, and it places the RRR businesses within the provisions made by the NPSWM. The policy directly suggests finding possible RRR business opportunities to minimize the amount of waste for disposal, ensure the health and well-being of the people and preserve the ecosystems. Therefore, the NPSWM promotes RRR businesses through opportunities from SWM and organic fertilizer sales that will be exempt from income tax. The policy clearly states that “sustainable waste collection systems should be established to make recycling economically viable.” Sorting waste at the source was recognized as a strategy to make recycling economically viable.

Additionally, obtaining the environmental protection licence (EPL) to undergo an RRR business become mandatory under the National environmental act (NEA) No: 47 of 1980 amended by acts No. 56 of 1988 and No. 53 of 2000. Section 23 A of the NEA states that no person shall carry out any prescribed activity except under the authority of an EPL and follow such standards and other criteria as may be prescribed under the act. EPLs is playing a key role in establishing environment friendly and legally structured RRR business culture in Sri Lanka. Industries and activities which required an EPL are listed in Gazette Notification No. 1533/16 of 2008. According to the standard criteria of EPLs, there is hardly any possible way to undergo the RRR business of medium to large scale without getting EPL.

At the same time, the Central Environmental Authority (CEA)⁶ has prepared several technical guidelines to support waste treatment at the national level. These guidelines on SWM are also designed for investors, LAs and other entities that plan to initiate or operate any SWM activity. There are three general guidelines available:

1. Technical guidelines on SWM in Sri Lanka of 2005 to support the SWM and siting of engineered landfills.
2. Technical guidelines on SWM in Sri Lanka of 2007 to support the construction of the engineered landfill.
3. Guidelines for the management of scheduled waste in Sri Lanka of 2009 targeting the management of scheduled waste to facilitate the implementation of Regulations on hazardous waste management of 1999.

The national waste management policy (2019) prepared by the Ministry of Environment in consultation with all relevant stakeholders is a revision of and an extension to the National strategy for SWM (2000) and the National policy on SWM (2007) covering all three types of waste: solid, liquid

⁶ CEA has formed a separate division named “waste management unit (WMU)” to handle the functions related to waste management. WMU deals with regulatory functions about hazardous waste management (scheduled waste management), SWM and chemical management under the provisions of the NEA and the other related regulations. Besides, WMU also provides necessary awareness and educational assistance to the general public on waste reduction and apposite handling of solid waste.

and gaseous. The mission of the policy is the “development of an eco-friendly nation by promoting resource circulation.” One of the stated guiding principles of the policy is that “waste management systems should be zero waste-oriented linking to life cycle management of products and processes as much as possible with appropriate technology” that has a direct relationship on the reduction of FW. The policy states that “strategies shall be developed by the LAs to promote the prevention of generation and reduction at source followed by source separation and further segregation as appropriate to facilitate regaining the utility value of household refuse as much as possible.”

The policy seeks the LAs to ensure the active engagement of all the households, institutions, and other commercial entities for the proper collection of municipal waste effectively and efficiently with a feedback mechanism. It has been recommended to identify appropriate tools and strategies able to apply the polluter pays principle and extended producer responsibility principle to maximize resource recovery and prevent scattering and haphazard disposal of waste. One of the actions proposed is the development of systematic mechanisms with tracking systems to know where what and how much waste is generated as premises for confirmation of the cause of waste generation aiming at establishing a sound and self-responsible society with life cycle thinking in resource utilization.

Regarding food, agriculture, and livestock waste, the policy advised the development of a comprehensive strategy and action plan by the Ministries of Agriculture, Trade, Tourism, Local Government, Health and Education to minimize the quantity of waste to be finally disposed of, in collaboration with the relevant stakeholders. According to the policy, FW generators (food handling establishments and kitchen waste) shall be responsible to develop their management plans and implement in consultation with relevant authorities to prevent health and environmental problems and guidelines shall be developed for food and agriculture waste prioritizing waste minimization targeting all sectors with appropriate standards to prevent contamination of water bodies and lands that would cause health and environmental problems. The policy promotes the application of cleaner production techniques to minimize hazardous contents and improve resource efficiencies at all levels.

According to the policy, the importation of post-consumer waste shall be prohibited. It has been proposed to carry out a comprehensive revision of the relevance, sufficiency, efficiency and effectiveness of the existing laws and regulations by the Ministry of Environment to support the implementation of the national policy to achieve the required transformation deviating from “linear waste management approaches” (make, use, dispose of) and moving forward to “circular systems” (keep resources in use for as long as possible, extract the maximum value from them whilst in use, then recover and regenerate products and materials at the end of its service life). It has been recommended to develop short, medium, and long-term strategies and action plans by leading institutions and agencies to minimize the waste to be finally disposed of by using an appropriate waste management hierarchy throughout the lifecycle.

Nuisances ordinance No. 15 of 1862: The ordinance was subsequently amended No.61 of 1939; No. 3 of 1946; No. 57 of 1946 was the first piece of legislation introduced in Sri Lanka during the colonial administration about waste management. It has identified improper waste disposal, wastewater, and drain usage at houses as a violation of the law, which can be fined a stated amount. The ordinance has given authority for city government and government sanitary inspectors to inspect, regulate, and control public nuisance, particularly inappropriate garbage disposal. The power vested by the ordinance is presently enforced by public health inspectors (PHI). Police ordinance No. 16 of 1865 provides authority to police to take action against improper disposal of waste. According to section 63(g) of the Police ordinance, any person who throws or lays down any dirt, filth, rubbish, or any stones or building materials can be taken into custody without a warrant if the person in view of the officers has committed any such offense. Such offenses are liable to a fine or imprisonment not exceeding three months.

Local councils' ordinances and acts: Urban council ordinance No 61 of 1939, Municipal council ordinance No 16 of 1947, Pradeshiya sabha act No 15 of 1987 are the major legislations governing the LAs in the country. According to the Municipal council ordinance No.20 of 1947 (Sections 129, 130 and 131), Urban council ordinance (sections 118, 119 and 120) and Pradeshiya sabha act (sections 93 and 94) all MSW management generated within the boundary of a LA is their property, and they are mandated to remove and dispose or sell of such waste materials without causing any nuisance to the public. These acts and ordinances provide power to the LAs to make the decisions on waste disposal sites and management of the site. The legal enactments of LAs on SWM have the following provisions:

a) All street refuse, house refuses, night soil or other similar matter collected by LAs under the provisions of this part shall be the property of the council and the council shall have full powers to sell or dispose of all such matter.

b) As per the National strategy for SWM of 2000, every LAs shall from time to time provide places convenient for the proper disposal of all street refuse, house refuse, night soil and similar matter removed per the provisions of the law, and for keeping all vehicles, animals, implements and other things required for that purpose and shall take all such measures and precautions as may be necessary to ensure that no such refuse, night soil, or similar matter removed following the provisions of the law is disposed of in such a way as to cause a nuisance.

However, the provisions specified in the act do not stipulate the requirement of environmentally friendly and most appropriate methods of waste disposal and it is a punishable offense in Sri Lanka. According to these provisions made in the local council's acts, it is an obligatory requirement of the LA in the area of concern for ownership and resource allocation on waste to ensure cleanliness and neatness within the respective council areas. To enable the entrusted function of managing the MSW of the LAs, the respective council has to obtain site clearance from CEA to construct MSW facilities including landfills. A facility that receives over 100 tonnes/day needs an Environmental Impact Assessment (EIA) approval from CEA, while the sites which receive less than 100 tonnes/day are required to obtain Environmental Clearance or Initial Environmental Examination (IEE) or EIA approval as per the act to operate a landfill site.

According to the technical guidelines issued on SWM in Sri Lanka, LAs make all the decisions related to the various aspects of waste collection and transportation including the waste collection areas, transportation routes, the number and type of collection vehicles to be used, purchase of vehicles and other equipment, frequency of waste collection and the schedule for collection and transport and recruitment of necessary workforce that would ensure the smooth operation of waste collection and transportation. Also, as per the regulations of the police and Road Development Authority (RDA), certain roads are prohibited for heavy vehicles at certain times of the day. Such rules and regulations should be taken into consideration when deciding the waste collection routes.

Composting is the major resource recovery approach largely adopted in Sri Lanka as approximately two-thirds of the waste consists of organic materials. However, there is an issue with the quality of the compost made from waste. Therefore, Sri Lanka Standard (SLS) 1246: 2003 (UDC 628.477.4) provides a general specification for the compost made from both MSW and agricultural waste. The specification was amended and improved by SLSI based on the collaborative work conducted with IWMI in 2019 developing separate SLS specifications for MSW compost (SLS 1634: 2019, UDC 628.477.4) and agricultural waste compost (SLS 1635:2019, UDC 628.477.3).

FW has not yet been considered directly in LAs legislation related to SW collection and transport. Urban Development act No 41 of 1978 regulates urban planning in Sri Lanka. The Urban Development Authority of Sri Lanka (UDA) was formulated under the purview of this act in 1978. The UDA is a multidisciplinary organization engaged in urban planning and sustainable urban development in Sri Lanka. The powers and functions of UDA described in part II of the act of said Urban development act

delegates power to the UDA to develop environmental standards and develop schemes for environmental improvements within the respective urban areas. UDA oversees finding innovative solutions to SWM issues to assist LAs in various waste management projects.

Prevention of mosquitoes breeding act No.11 of 2007: The act also prohibits the disposal of waste that would create a condition favorable for mosquito breeding. Regulations published under the gazette No. 1627/19 National environmental (municipal solid waste) regulations, No. 1 of 2009, specifies that no person shall dump MSW along sides of any national highway and should be dumped in the places designated for such purpose by the relevant LA or any person or body of persons authorized by them in that behalf. The regulations provide power to take legal action or impose punishment under section 31 of the act, for those who are violating these provisions.

National thoroughfares act No. 40 of 2008: dumping of solid waste or sending wastewater or liquid waste to the road is prohibited and actions could be taken against the violators.

Legislations related to FW management

Imports and export control act of 1969: Food quality control in the country works at three levels: import control, domestic control and export certification. Imports and export control act of 1969 provides powers to inspect the imported food items at the port of arrival and post arrival at the markets. Domestic control is done under the Food act of 1980 through authorized officers. All exporters need to be registered under the Imports and Exports Control act that provides export certificates.

Food act, No.26 of 1980: FW associated with spoilage occurs due to various types of microorganisms making food unacceptable to the consumer and changing smell, taste, appearance and texture. Assuring the supply of safe food through a well-established regulatory system able to reduce untimely food spoilage and subsequent FW. The Food act No.26 of 1980 is the main legislation governing Food Control activities in Sri Lanka. The general objectives of the Food act are to ensure the availability of safe, wholesome and genuinely presented food in the market for human consumption. The Food Act also applies to control, manufacture, importation, sale, distribution, transportation, advertisement and labeling of food. The main purpose of the act is to ensure availability for sale and prohibition of any misleading conduct.

Food act No 26 of 1980 and the subsequent amendments in 1991, 2011 have several provisions to control and regulate food manufacturing, food preservation, food safety and hygiene, food transport methods, imports, sale/expose to sale, storage and distribution. There are also provisions to regulate the labeling, packing and advertising standards, to prevent the creation of the wrong impression on character, quality, value, composition, or safety of the given food. According to the Food act, the sale of food unfit for human consumption or sale for use as feed is not allowed except with the permission of and in accordance with the direction issued by the chief food authority or such other person authorized in writing on that behalf.

Food act No. 26 of 1980 also has issued Gazette No. 1694/5 focusing on expiry dates of food items that give an idea about the shelf-life period as well as indicate the suitable time for the next cycle of food production. Effective use of packaging can increase the shelf-life of food products. The regulations on the shelf-life of imported food items stipulate that all items of food imported to the country except fruits, vegetables and potatoes possess a minimum period of 60 percent of unexpired shelf life at the moment of entry.

The gazette No. 560/13 issued under the Food act No. 26 of 1980 is addressing the regulations related to premises of food preparation, storage or sale and cleanliness of articles and equipment. Good quality food products tend to produce less waste where food preparation, storage and sales premises should follow accepted building requirements and ventilation and adopt the regulation concern on

the cleanliness and hygiene practices of the premises used to prepare food. These procedures ensure minimal contamination of foods during food preparation/processing.

Under the Food Act, a new regulation was Gazetted in 2019 (No.2128/4) as “Food (Registration of Premises) Regulations of 2019” and came into operation from 01.01.2020. According to the regulations, every person who manufactures, prepares, preserves, packages, stores, any food for sale or offers for sale in a premise should register such premises with the relevant food authority and the approval will be given after the inspection of the premises as per the guideline and the medical reports of the food handlers. The regulation empowers the authorized persons to take actions to ensure food safety in case of violation of stipulated conditions. Except for these regulations, no other regulations address the hygiene of food directly or indirectly that has a relationship to food spoilage resulting in FW generation.

In this context, Sri Lanka has taken steps to review the Food act no. 26 of 1980 and its subsequent amendment made in 1991. Under the provisions made in the act, the Ministry of Health has published several regulations and is in the process of drafting new regulations based on current needs related to food safety. The National food control system in Sri Lanka is further strengthened by the implementation of the Consumer Protection Authority act of 2001 and the Drugs and Cosmetic act of 1980 (Munasinghe *et al.*, 2014).

Consumer Affairs Authority act No 09 of 2003 has legal provisions empowering the Consumer Affairs Authority (CAA) to take necessary actions to safeguard the interests of consumers while maintaining effective competition among suppliers of consumer products. CAA can handle consumer complaints and has a role to play in consumer education and empowerment. CAA is a member of the National food advisory committee (FAC).

Sri Lanka Standard Institution (SLSI) is responsible for disseminating information on standards, technical regulation and standards related activities to the community at the national level. It promotes the volunteer adoption of SLSI standards intending to assure the safety and quality of foods, provide third-party certification to both consumer and producer and to enhance the industry recognition of the food operator. However, SLSI has imposed compulsory standards for several food product categories in Sri Lanka, including brown sugar, canned fish, condensed milk and fresh fruit cordials. There are 33 stipulated food products that need the approval of the Director General of SLSI at importations to ensure the quality and safety in line with the food standards stipulated in Codex and ISO. SLSI is one of the members of the FAC.

FW prevention and reduction are not yet (in 2020) directly included on the agendas of the organizations handling food production, food processing, sustainable development, combatting climate change effects and waste management. **Table 2** on P. 16 describes how major legislations and policies dealing with food and bio-waste management cut across the different stages of waste management without directly addressing FW reduction except through composting⁷ and separation of recyclables to minimize volumes going to landfill sites.

One of the gaps identified in the existing regulatory environment, is that, despite the availability of a large number of acts and policies, the system has unable to introduce sufficient necessary law enforcement mechanisms for effective implementation. Pilots on the segregation of biodegradable waste at the household level have been in practice in several LAs in the western province and many other areas. Nonetheless, source segregation of FW and resource recovery from FW (for example, compost) is not widely practiced or promoted at the national level. LAs have not yet developed

⁷ Biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises and comparable waste from food processing plants (European Commission, 2008).

comprehensive by-laws that promote FW prevention, reduction, reuse and recycle (RRR) and source segregation.

Table 2. Governance analysis matrix for food waste prevention and reduction in Sri Lanka

	Local author ities acts ¹	Provi ncial coun cils act No. 42 of 1987	NEA No. 47, 1980, act No 56 of 1988 and act No. 53 of 2000	Food act No. 26 of 1980	Nuisance ordinanc e No. 62 of 1939 and No 57 of 1946	Solid waste manage ment policy, 2007	Waste managem ent policy 2018 (Draft)	National policy on sustainable consumption and production policy of 2019 (SCP)	National nutrition policy of Sri Lanka-2010	National climate change policy of 2012	National policy and strategy on cleaner production for Fisheries sector-2008	National policy and strategy on cleaner production for agriculture sector- 2012
Waste prevention	x	x	x	x	x	✓	✓	✓	x	✓	✓	✓
Waste reduction	✓	✓	✓	x	x	✓	✓	✓	x	✓	✓	✓
Waste segregation	x	x	✓	x	x	✓	✓	✓	x	✓	x	x
Reuse of FW/ redistribution	x	x	x	x	x	x	x	✓	x	x	x	x
Waste recycling	✓	✓	x	x	x	✓	✓	✓	x	✓	x	x
Waste disposal/land filling	✓	✓	✓	x	✓	✓	✓	✓	x	✓	x	x
Food processing, preservation/ hygiene	x	x	x	✓	x	x	x	✓	✓	x	✓	✓

Note: 1. Urban council ordinance No. 61 of 1939, Municipal council ordinance No. 16 of 1947 and Pradeshiya sabha act No. 15 of 1987.

2.4 Provincial policies and regulations

Under the 13th amendment made to the constitution of 1987, LAs are under the purview of PCs. The rights of LAs relating to waste management were handed over to the PC as per the provincial council act No. 42. Therefore, the respective PCs and LAs need to adopt appropriate institutional arrangements and formulate regulatory systems adopting provincial-level policies, strategies, laws and by-laws to achieve the devolved tasks. To assist the task of PCs, CEA has established Provincial Offices and district offices providing services to the people and industrialists who require services. The Provincial CEA Office is headed by a Regional Director and is supported by Assistant Director, Senior Environmental Officers (SEO) and Divisional Environmental Officers (DEO).

The PCs are empowered to make all decisions on capacity building, resource allocation and adopting a provincial-level policy on SWM projects. It is the responsibility of the PCs to help and guide the LAs in the execution of waste and sanitation-related activities. The PCs are also the main regulatory bodies for supplying equipment and allocating sufficient resources to perform the function of SWM in the LAs in the Province. Also, any foreign-funded waste management projects implemented in the province should be coordinated and regulated by the respective PC.

As per the authority given to the LAs under the Local council acts and ordinances, each council shall focus on by-laws to be made in promoting waste management. The PCs will consider the National policy on solid waste and its strategies with a view of waste reduction, minimization, waste segregation and resource recovery against waste. For instance, the following strategies are considered in formulating by-laws under the LAs act in addressing the problem of SWM:

- Promote the composting of bio-degradable waste and release it back to the environment in a healthy and environment-friendly manner.
- Provide all necessary measures to encourage resource recovery from recyclable waste materials such as paper, plastics, metals and glass.
- Take all possible measures to minimize adverse effects and damage being caused to the environment such as pollution of water, soil and air.
- Utilize methods such as sanitary landfilling for the disposal of waste to reduce any adverse impact on the environment.

The PCs and LAs have made different regulatory and institutional arrangements to handle the delegated function of waste management. For example, under the policy guidelines given in the NPSWM, Western provincial council has enforced the municipality SWM rules No.01 of 2008. The rule promotes the separation of waste at the source adopting a clause, "Every MSW generator shall maintain a minimum of two containers mainly for biodegradable and non-biodegradable wastes set out in Schedule 1. Such containers shall have lids with sufficient space to accommodate the daily collection of waste without spilling any waste outside such containers. The waste generator may have more than one container for non-biodegradable wastes such as papers, plastics and glass, and so on., No generator of waste shall mix their toxic or clinical wastes with the MSW." This provision is applicable for MSW generators in the eastern Province where Colombo, Kaduwela and Kotte municipal councils are strictly adapting in their daily waste collecting from the generators.

The same rule adopted by the western PC also specifies that every LA in the western province should collect organic waste twice a week and the time of the collection should be informed to residents in advance. A similar awareness should be given to non-organic waste generators (residents/businesses) as well where it should be collected at least in a fortnight. According to the accepted policy of the national SWM of Sri Lanka, 'polluter should pay the cost'. The municipality SWM rules suggest the ability of LAs to collect a fee for waste collection in the western province. There are LAs in the eastern

province who have introduced such a charging system. Accordingly, LKR 20⁸ (USD 0.10) from Samurdhi families (families under the government poverty alleviation program) and LKR 50 (USD 0.25) from others have been charged to cover up the portion of SWM cost (Eastern provincial council, 2012).

Another statute of the Western provincial council, No. 03 of 2012, adopted to enforce the preventing public health nuisances has also recognized putting waste materials into water, throwing garbage to the road or drain or public places, keeping garbage or any such thing threatening public health and allowing wastewater and toilet water to flow as a disturbance for public health is considered as offensive disposal of waste.

The western province has established a separate organization called Western Province Waste Management Authority in 2004 to act upon their entrusted task on waste management under statute No. 09 of 1999. The statute on waste management was amended as No. 01 of 2007 to further strengthen the legal status of waste management. Western provincial council introduced SWM rules No 01 of 2008 via the Extraordinary Gazette No 1560/6 on 30th July 2008 to get the legal support to implement the seven management steps in MSW management.⁹

Similarly, the north-western province has created its own Provincial Environmental Authority. Despite the own arrangements for SWM in some of the PCs, it has been noted that the active engagement and support provided by the PCs in MSW management are not adequate except for the Western provincial council (Karunaratna, n.d.). The North-Western provincial council (NWPC) has formulated Provincial environmental statute No. 12 of 1990. Under the provisions given in the statute, the Provincial environmental act of 1991 was adopted superseding the NEA except for areas under the Department of Wildlife Conservation or Department of Coast Conservation and Coastal Resources Management. The act provides power to the NWPC for the establishment of the North-Western Provincial Environmental Authority, to make provision concerning the powers, functions and duties of the authority and to make provision for the protection, management and enhancement of the environment and the regulation maintenance and control of the quality of the environment.

The by-laws adopted by the councils may vary from place to place depending on the context and requirements. The by-laws adopted by the Colombo municipal council (CMC) on food safety and food waste are listed in **Annex 1** on P. 25. The provincial waste management functions are linked with the central government through the Ministry of Public Services, Local government and Provincial Councils, which is responsible for the implementation of policies, plans and programs in respect of PCs and LAs.

2.5 Non-state measures

There are hotels, restaurants and caterers, private traders, supermarkets, NGOs and charity organizations that have adopted self-regulation and voluntary standards as a measure to reduce FW and invest in reuse and recycling practices due to ethical and moral reasons, economic benefits, environmental concerns and as a part of corporate social responsibility (CSR) (Sandaruwani, and Gnanapala, 2016; Kumara *et al.*, 2018; Reitemeier, 2019).

The large tourist hotels which are keen to obtain international green awards/environmental awards implement waste minimization (reduction, reuse and recycling); wastewater management, and implementation of environmentally sensitive purchasing (for example, hotels Heritance Kandalama, Heritance Ahungalla and Sigiriya).

⁸ 1 USD=LKR 199 in July 2021.

⁹ Seven steps are; Evaluate your waste, store your waste, label the waste, transport and dispose your waste properly, plan for emergencies, train personnel, keep records.

Another method adopted by some supermarkets, restaurants and caterers to curb FW is collaborations with local charity organizations to redistribute the food in good conditions to the families in need. WeGiveStuffAway (WGSA) and the Robin Hood Army are two such organizations. These kinds of food rescue programs are being implemented by many to support families in need, elders' homes and orphanages in their contacts.

2.6 Gaps

The roles and responsibilities of stakeholders and actors in SWM are well articulated in the existing policy frameworks, but these roles are not yet well operationalized (Marasinghe, 2018). Policies dealing with food production and bio-waste management are not directly addressing the question of FW reduction or reuse, despite the fact that FW is one of the major categories of SW generated and is posing a pollution threat to the open and underground environment.

The exception is the National policy and strategy on cleaner production for agriculture sector of 2012, the National policy and strategy on cleaner production for fisheries sector of 2008 and the sustainable consumption and production policy of 2019 that have provided attention to FW reduction to zero FW. The overarching agricultural policy 2020–2025 of 2019 and the latest National agricultural policy of 2021 have paid attention to the entire food value chain. Existing policies and legislations are mainly on minimizing the waste going to landfill sites.

Food Control Administration Unit (FCAU) of the Ministry of Health is the central food safety and quality controlling body, with no jurisdiction over agricultural production. However, the latest National agricultural policy of 2021 has called the consultation and collaboration requirement with the Ministry of Health and Sri Lanka Standards Institute to develop food safety standards and regulations for agricultural products. The existing general guidelines of the Food act are limited to conditions stipulated on food processing given the provisions made in section 32 of the act (Hygiene and regulations, 1989). The central food control administration system has, therefore, failed to impose mandatory legislations to have a well-structured preventive measure of good practices such as good agricultural practices (GAP), good management practices (GMP), and hazard analysis critical control points (HACCP) aiming to eliminate food hazards and quality losses. Therefore, the regulation of artificial ripening practices, phyto-sanitary aspects and trade of fresh fruits and vegetables internationally, and so on are out of the mandate of FACU. However, Sri Lanka has developed HACCP systems for several food processing industries, though it is not yet compulsory to adopt. Therefore, the application of the HACCP system to great numbers of small and medium to large scale food processing factories is mostly not practiced.

Another gap in ensuring food safety at LA level is due to a lack of capacity, especially of laboratory facilities. According to section 17 of the 1980 Food act, the authorized officer for enforcement is the government analyst, but the Minister-in-charge of Local Government has the power to appoint additional analysts for LAs. Currently, food quality control laboratories are available in Colombo and Kandy municipal councils, food quality control laboratory in Anuradhapura, provincial food quality control laboratory in Kurunegala, Medical Research Institute, Colombo and National Institute of Health Sciences, Kalutara with additional analysts. There is a lack of adequate capacity in testing and inspection facilities. Food safety aspects are nationally regulated and monitored by the 1980 Food act, while local-level governance is decentralized, and it is under the purview of LAs. However, there is a missing link between the two-layer administration system on the effective implementation of food control administration.

3. Conclusions and recommendations

Governance analysis allows a comprehensive understanding of state and non-state challenges and solutions towards FW prevention and reduction. In Sri Lanka, for instance, though policies on waste management are focused on promoting RRR businesses, the enabling environment should be created to motivate private sector organizations to enter the space of SDG 12.3.

LAs are the main entities entrusted with the function of waste management at the local level. Segregation of FW at source would provide quantitative evidence for scaling up measures on prevention and reduction. LAs by-laws could provide socioeconomic incentives and enforce reduction mechanisms such as measurement and reporting by food business operator type and/or introduce penalties for high FW while also implement programs of capacity development such as sanitary inspections and quality assurance for small-scale food establishments.

The requirement of the HACCP system is increasingly important for food business operators, such as rice, vegetables and fruit production, processing and distribution as their demand and consumption have increased greatly (Munasinghe *et al.*, 2015). Food safety challenges at food business operators' level can be addressed to a large extent by adopting effective HACCP systems and its adoption would reduce the cost of regulatory enforcement and ensure the periodic verification of quality standards.

On the FW prevention side, legal and operational guidance on FW prevention and reduction for wholesalers, supermarkets, retail outlets and restaurants on recovery and redistribution of safe and nutritious food for direct human consumption could facilitate the adoption and scaling up for this prevention opportunity. Some food services (such as retail outlets, hotels) have voluntarily adopted measures to conserve natural resources while supporting food insecure individuals with safe and nutritious food that is nonsaleable. However, this is not replicable widely unless (voluntary) standards for FW prevention and reduction are launched.

For reducing FW, legal and operational guidelines are also necessary for former foodstuffs to feed (see **Annex 5** on P. 32, for a list of examples from other countries). Nevertheless, it is noted that this is a solution that should clarify boundaries and not compete with the recovery and redistribution of safe and nutritious food for direct human consumption.

Existing FW research and projects conducted by universities should be consulted by the public sector to identify scalable solutions that could be communicated through a FW national platform for civil society and private sector information and awareness raising. The public sector and universities, in collaboration with the private sector, could also launch actions on strengthening food literacy for consumers of all ages, in view of facilitating healthy and sustainable diets in parallel with FW reduction.

Waste of fruits and vegetables impact the availability and affordability of these products for healthy diets. Although some of the fruits produced during the peak seasons are processed into jams and juice, technologies for dried fruits should be enhanced for local as well as international markets (Gunawardana and Wanninayake, 2018). Policy and technological support should be strengthened to promote technology adoption and availability, in parallel with nutrition awareness and marketing for all income groups.

LAs should work towards ameliorating the acute shortage of trained personnel such as food inspectors, analytical chemists and microbiologists. It is important to have policy support and adequate budget allocations for capacity development that directly impact FW prevention and reduction opportunities. Public awareness programs about food safety and hygiene-where both commercial stakeholders and consumers are involved-are necessary.

Socioeconomic and environmental business-oriented innovations are needed to drive the change from bio-waste management to prevention of FW through education, civil society support and private sector involvement. Working groups in food, nutrition, waste, health, education and climate change sectors could integrate FW prevention and reduction as a win-win strategic approach.

Awareness of the reduce, reuse and recycle (3R) concept among policymakers and administrators at LA level is low and their attention is mostly on recycling, not on reduction and reuse (Kuruppuge and Karunarathe, 2014). At the same time, due to unclarified boundaries and unidentified business and social opportunities for FW prevention, some LAs encourage organic waste generation to make composting facilities commercially viable (Kuruppuge and Karunarathe, 2014). Regulations need to focus on socioeconomic incentives as well as tools for facilitating behavior change for supply chain actors and consumers.

Governance, expressed through revisions of current tools or the introduction of new measures, should not place in competition with each other solutions that work on prevention at source (for example, better management of stocks, optimized food packaging, cold transportation) and recovery and redistribution of safe and nutritious food for direct human consumption for non-salable food, with actions that recover value from former foodstuffs through feed as well as options concerning recycling for bio-materials, compost or energy recovery.

FW prevention should be supported by a sufficient budgetary allocation that includes the public education sector and multi-disciplinary awareness raising campaigns. Local councils could encourage residents through formal or informal educational activities at the community level. Activities could be implemented in kindergartens, schools, higher educational institutes, universities, hotel schools and other vocational institutions (FAO, 2021).

The *urban roadmap and action Plan on food waste prevention, reduction, management in Sri Lanka* identifies concrete steps to implement towards achieving Sustainable Development Goal 12.3 (SDG 12.3).

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5. Annexes

Annex 1. Legislative and policy framework related to food production

Policy/Act/Regulation	Reference Area
National seed policy (1996) The seed act (2003) National agriculture policy (2007) Paddy marketing board (PMB) act (1971) and amended Act (1978)	Ensure high quality of the imported and locally produced seed; Regulate seed testing and certification and planting material production of food crops; Guide production support and service delivery under different Ministries and line Departments. Provide regulatory provisions for the establishment of a board to purchase, sell, supply, distribute and process paddy and rice.
Agrarian development act No. 46 of 2000	Development of minor irrigation, rainfed cultivation, and agricultural support services.
National livestock development policy (2006) Animal breeding policy guidelines (2010) The animal feed (amended) act (2016)	Guide production support and service delivery, breeding guides for cattle, buffaloes, goats, sheep, and pigs; Quality of the semen imported for artificial insemination; Vaccination and drugs required to provide quality veterinary service; Provide high-quality feed material to the livestock and poultry industry.
The pesticides control act (1980)	Regulate the import, distribution, and use of pesticides.
The export agriculture promotion act (1992) National policy on export agricultural crops (2018)	Authorizes Department of Export Agriculture (DEA) to provide service delivery function on export agricultural crops; updated policy environment.
Fisheries and aquatic resources act (1996) National fisheries and aquaculture policy (2018)	Legal authority relating to the sector and providing a regulatory framework on the use of fisheries genetic resources.
The national plantation industry policy framework (2006)	Tea, rubber, coconut and sugarcane sector on the provision of planting materials and extension services.
Crop insurance act (1961) Agricultural insurance law (1973)	Regulates the undertaking of agricultural insurance for specified crops and livestock; Makes provision for compulsory insurance and establishment of crop insurance advisory board.
Agricultural and industrial credit corporation (amendment) act No. 5 (1970)	Regulates the functions of agricultural and industrial credit.
Agricultural products (guaranteed prices and control of hulling and milling) act, No. 33 of 1961	Grading, and the fixing of guaranteed prices for certain agricultural products.
Regulation of fertilizer act, No. 68 of 1988	Importation and distribution of fertilizer; licensing of private fertilizer imports.
Mahaweli Authority of Sri Lanka Act No. 23 of 1979 (as amended) and the regulations	Food production in the Mahaweli river basin areas.

Source: Adopted from the Government of the Democratic Socialist Republic of Sri Lanka. 2019. *Overarching agricultural policy 2020-2025*. Government of the Democratic Socialist Republic of Sri Lanka. (also available at <https://www.eusl-ruraldevelopment.org/wp-content/uploads/2020/05/2019.pdf>).

Annex 2. By-laws on food security and related aspects of Colombo municipal council

	Municipal council ordinance (No. 29 of 1947)	CMC by-laws
Food safety	<p>272(19)- The regulation, supervision, inspection and control of the sale, or the storage or manufacture for the purpose of sale, of articles of food or drink including the sale, or the storage or manufacture for the purpose of sale, of such articles at hotels, shops and places other than markets.</p> <p>272(20)-</p> <ul style="list-style-type: none"> • Itinerant vendors, including—the supervision or control of itinerant vendors. • The issue of licences for the purpose of such supervision or control, and the conditions to be attached to such licences. • The regulation or prohibition of the sale of any specified article or the sale of articles in any specified place or area. • Facilitating inquiry in connection with the spread of infectious or contagious diseases through dairies. • The inspection of dairies and dairy cattle and the medical examination of those engaged in Dairies or the distribution of milk for sale. • The cleanliness of premises in which milk is kept, and of milk shops, and of vessels used for containing milk for sale. • 272(2)- the structure and stability of walls, foundations, roofs and chimneys of new buildings, the prevention of fires and purpose of health 	<p>Bylaws related to eating venues, 1962</p> <p>The premises must be equipped with a kitchen which has</p> <ul style="list-style-type: none"> • A minimum superficial floor area of 120 square feet and are least one window capable of being opened on to an external open space. • Expect where cooking is done by gas or electricity, an efficient smoke vent. • The eaves of the building must be not less than 6 feet from the ground. • The premises must be provided with adequate surface drainage, and a sanitary dustbin. • No licensee in charge of mobile eating houses shall permit any person who is suffering from or who has recently suffered from any contagious, cutaneous, infectious, or loathsome disease, to enter the eating house or to take part in the preparation or sale of any food or drink therein, until the periods of infection and incubation have elapsed. • Every licensee shall keep the licenced premises free from rats or other vermin and shall cause all rat holes to be filled with broken glass and plastered with cement. <p>Seizure of articles unfit for intake</p> <ul style="list-style-type: none"> • Prohibition of the mixing of injurious ingredients and of selling the same • No person shall expose for sale any cooked food, pastry, sweetmeats, confectionery, or preserved or dried fruit intended for human consumption unless he has taken all reasonable precautions to protect it from dust, flies and bad odors. • Except as otherwise provided in these bylaws, no carcass of any animal not slaughtered at a municipal slaughterhouse shall be brought into a public or private market. • No owner, occupier, or lessee of or vendor shall sell or expose or permit to be exposed for sale or permit to remain in, any such market or shop any noxious or unwholesome meat, offal, or fish and so on. <p>Under the ordinance 8 of 1901</p> <ul style="list-style-type: none"> • It shall be lawful for a municipal inspector or superintendent of a slaughterhouse, upon the seizure by him as unwholesome or unfit for human food of any meat, poultry, fish, game, flesh, vegetable or other article, he shall order the same to be destroyed or to be disposed. • No person shall mix, colour, stain, or powder, or order or permit any other person to mix, colour, stain any article of food with any ingredient so as to render the article injurious to health. • No person shall expose for sale any cooked food, pastry, sweetmeat, confectionery, or preserved or dried fruit intended for human consumption unless

		<p>he has taken all reasonable precautions to protect it from dust, flies and bad odor.</p> <ul style="list-style-type: none"> • It shall not be lawful for any person to sell, hawk about or expose for sale any cow's milk or buffalo's milk which has been adulterated. • No person shall in any market or shop shall sell, or expose or permit to be exposed for sale, or admit into , or permit to remain in any such market or shop any noxious or unwholesome meat, offal, or fish or decomposed vegetable matter.
Nutrition	<ul style="list-style-type: none"> • 272(23) The standardization of milk and prevention of the sale of milk below prescribed standard. • The determination of the deficiency in any of the normal constituents of genuine milk, cream, butter or cheese 	<ul style="list-style-type: none"> • No licensee shall keep or sell any cow's milk, which contains less than 12 per centum of milk solids, or less than 3.5 per centum of milk fat, or any buffalo's milk, which contains less than 16 percent of milk solids or less than 7 per centum of milk fat. • No person shall sell or offer for sale any milk from which the cream has been removed unless he previously informs the person to whom he sells or offers it that the cream has been removed. • Prohibition of the mixing of injurious ingredients and of selling the same.
Food waste and losses	<ul style="list-style-type: none"> • The seizure, forfeiture and removal and destruction of unwholesome flesh, fish, or other provisions • The seizure and removal of articles exposed for sale on contravention of any by-law. • 272(5)- sanitation including-the inspection, regulation, maintenance and cleansing of all drains, privies, earth closets, cesspools, ash pits and sanitary appliances. 	<p>By-laws relating to eating venues</p> <ul style="list-style-type: none"> • Every licensee shall cause all refuse and dirt to be placed in an impervious covered receptacle until removed by the scavenging laborers of the council. • No licensee shall permit any waste tea, coffee or milk or remnants of food to be thrown on the ground. • Night soil, dung, or other filth, dust, dirt, ashes, rubbish, or refuse to be deposited only in the place provided. • To cause filth, garbage to be promptly removed to the receptacle and market to be swept and cleaned and washed. • Every person holding a licence for a stall in a public market shall keep on or near such stall a receptacle to be approved by the chairman, in which such person shall deposit all rubbish and refuse matter.

Source: Authors' elaboration

Initiative examples	Company examples	Description
National alliances		
National food waste reduction pacts (I) (UK; 2018)	The United Kingdom of Great Britain and Northern Ireland FW Reduction Roadmap, with more than 150 companies, including all main grocery retailers in the United Kingdom of Great Britain and Northern Ireland	To help food and consumer goods companies reduce their FW, the companies are committed to target, measure and act on their food waste, with 121 already reporting on progress. These 121 companies have a combined turnover of half of the overall turnover for the United Kingdom of Great Britain and Northern Ireland food manufacture, retail, and hospitality food service.
National food waste reduction pacts (I) (Canada; 2019)	Kraft Heinz (Canada), Loblaw Companies Ltd, Maple Leaf Foods, Metro Inc., Save-on-Foods, Sobeys Inc., Unilever (Canada), Walmart (Canada)	The group of eight companies is committed to reduce FW in their Canadian operations by 50 percent by 2025.
National food waste reduction pacts (II) (USA; 2016)	United States of America (USA) FLW 2030 Champions	With support by the United States Department of Agriculture (USDA) and the United States Environmental Protection Agency (EPA) this group of businesses and organizations made a public commitment to reduce FLW in their own operations in the United States by 50 percent by the year 2030. ¹⁰
Multi-national alliances		
Global alliances I (2015)	The European Union (EU) based International Food Waste Coalition (Founding members: Ardo, McCain, PepsiCo, SCA, Sodexo, Unilever Food Solutions, WWF)	The coalition uses a farm-to-plate value chain approach for impacting local, national and international regulations as well as conducting specific projects (for example, with FAO on schools) aimed at the end-users achieving measurable results and creating momentum in society.
Global alliances II (2016)	The Consumer Goods Forum of about 400 retailers, manufacturers, service providers, and other stakeholders across 70 countries	In June 2016, the first-ever global standard to measure FLW, the FLW Standard ¹¹ was introduced through an international partnership. The standard is a set of global definitions and reporting requirements for companies, countries and others to measure, report on and manage FLW consistently and credibly.
Global alliances III (2017)	Global Agri-business Alliance	Supporting SDG 12.3 includes measuring FLW as part of the food and agricultural loss resolution (using a common FLW accounting and reporting standard).
Global alliances IV (2018)	Ten of the world's largest food brands including Mars, PepsiCo, Tesco and Unilever	Committed to halve their FW by 2030, to publish the FW data for their operations, and to take concrete steps to reduce FW in the supply chain and in customers' homes.
Global alliances V (2019)	Sustainable Rice Platform	Represents some of the largest rice producers in the world, the platform is committed to implementing the target-measure-act approach and to halving on-farm and near-farm rice losses by 2030.

¹⁰ <https://www.epa.gov/sustainable-management-food/united-states-food-loss-and-waste-2030-champions>

¹¹ Available at: <https://flwprotocol.org/flw-standard/> (Consulted on 15 July 2021).

Global alliances VI (2019)	“10x20x30” FLW Initiative by AEON, Ahold Delhaize, Carrefour, IKEA Food, Kroger, METRO AG, Pick n Pay, The Savola Group, Sodexo, Tesco, and Walmart	An initiative to engage the supply chains in the fight against FLW. The initiative brings together ten of the world’s biggest food retailers and providers to each engage with 20 of their priority suppliers to aim to halve rates of FLW by 2030.
Company examples		
Company commitments (I)	Sysco	Committed to divert 90 percent of FW from landfill by 2025 from the current level of 65 percent. To help meet this goal, Sysco is working on repurposing and donating excess food and redirecting FW through the agricultural feed.
Company commitments (II)	Google	Since 2014, over 2700 tonnes of FW avoided by implementing Lean Path technology across 189 cafés and using the information to alter menus and purchasing, repurposing trims of food that would otherwise be wasted into other products and donating any surplus food to those in need.
Company commitments (III)	Kellogg Morrisons, Co-Op	Since 2016, a 12 percent reduction in organic waste (FW plus animal feed and biomaterial/processing) across its global manufacturing plants (Kellogg). Since 2016, a 13 percent reduction in food waste (Morrisons). Since 2015, a 29 percent reduction in FW (Co-Op).
Company commitments (IV)	Tesco	Between 2017-2019, Tesco in the United Kingdom of Great Britain and Northern Ireland achieved a 63 percent increase in the amount of surplus food redistributed to charities, community groups, colleagues, and animal feed. This resulted in a 51 percent decrease in the amount of food safe for human consumption going to waste (energy recovery) and a 17 percent reduction in total FW in tonnage. Between 2016 and 2020–2019 Tesco Central Europe reduced its total FW by 47 percent through reducing surplus and increasing the amount of surplus food redistributed to charity partners.
Company commitments (V)	Nestlé	Between 2017 and 2018, Nestlé reduced milk losses during transportation from the farms to the factory by nearly 40 percent.
Company commitments (VI)	Sodexo	In June 2019, Sodexo, which serves more than 100 million meals a day, announced activities with a data-driven waste management program called “WasteWatch powered by LeanPath”, to be deployed across 3 000 sites worldwide.
Company commitments (VII)	Kroger	Kroger, the second largest food retailer in the United States, estimated that in 2017, 27 percent of retail store FW was diverted from landfills, and in 2018, 40 percent, supported by better store engagement and execution.

Source: Authors' elaboration; based on World Resources Institute (WRI). 2019. SDG Target 12.3 on FLW: 2019 progress report. An annual update on behalf of Champions 12.3. WRI and Ministry of Agriculture, Nature and Food Quality, Government of Netherlands (also available at <https://champions123.org/publication/sdg-target-123-food-loss-and-waste>).

Annex 4. European Union examples of governance for food waste prevention and reduction

Policies and Regulations	Descriptions
General Food Law: Regulation (EC) No 178/2002	<ul style="list-style-type: none"> • This regulation applies to all food business operators placing food on the market, including redistribution organizations and other charity organizations. • All actors in the food chain shall ensure that food satisfies the requirements of the General Food Law. • A food business operator is held responsible for compliance with all food law requirements (such as food safety, food hygiene, food information for consumers) for activities occurring in the part of the food chain under its own control (Art. 17). • Activities related to private domestic use and consumption of foods are excluded from the scope of the Regulation.
Food hygiene package: Regulation (EC) No 852/2004 on the hygiene of foodstuffs Regulation (EC) No 853/2004 specific hygiene rules for food of animal origin	<ul style="list-style-type: none"> • All food business operators have to comply with European Union rules related to food hygiene. • It is necessary to ensure food safety throughout the food chain, starting with primary production. • It is important for food that cannot be stored safely at ambient temperatures, particularly frozen food, to maintain the cold chain. • Good hygiene practices and procedures based on HACCP principles, where applicable, need to be complied with throughout the food chain. • Specific requirements apply for distribution/donation of foods of animal origin. • Hygiene rules should apply only to undertakings, the concept of which implies a certain continuity of activities and a certain degree of organization (recital 9 of Regulation (EC) No 852/2004).
Food labeling and durability: Regulation (EU) No 1169/2011 on the provision of food information to consumers, and repealing Commission Directive 87/250/EEC, and 1999/10/EC, Council Directive 90/496/EEC, Directive 2000/13/EC of the European Parliament and of the Council, Commission Directives 2002/67/EC and 2008/5/EC and EC Regulation No 608/2004	<ul style="list-style-type: none"> • Food business operators are required to indicate a 'best before' or a 'use by' date. • The marketing of foodstuffs beyond their 'best before date' is allowed under European Union law (but the distribution of foods past the "use by" date is considered unsafe and therefore prohibited). • Rules on the provision of food information to consumers shall apply only to undertakings, the concept of which implies a certain continuity of activities and a certain degree of organization.
VAT rules: Council Directive 2006/112/EC	<ul style="list-style-type: none"> • According to council directive 2006/112/EC, VAT has to be paid on food intended for the donation if the VAT paid by the donor upon purchase has been deducted. • The taxable amount is the purchase price at the moment of the donation adjusted to the state of those goods at the time when the donation takes place. • Recommends that – for foods which are close to the 'best before' date, member states should consider the value on which the VAT is calculated to be low, even close to zero in cases where the food genuinely has no value.

Official controls: Regulation (EC) No 854/2004 Regulation (EC) No 882/2004 Regulation (EU) 2017/625	<ul style="list-style-type: none"> • Controls of establishments producing products of animal origin intended for human consumption. • Controls to ensure compliance with food and feed legislation, animal health and welfare rules. • Addresses official controls and other official activities performed to ensure the application of food and feed law, rules on animal health and welfare, plant health and plant protection products.
Waste framework directive (WFD) Directive 2008/98/EC	<ul style="list-style-type: none"> • Establishes waste prevention as the first step of the waste hierarchy and requires the member states to set up waste prevention programs. • Calls on the member states to reduce FW at each stage of the supply chain, monitor FW levels and report on a biennial basis. In 2020, the European Commission adopted a methodology to measure FW based on favorable opinion of member states as well as it is providing training to governments for its adoption and application.
Common organization of the markets in agricultural products Regulation (EU) No 1308/2013	<ul style="list-style-type: none"> • The related legislation provides higher support for free distribution (charity withdrawals) than for withdrawals for other destinations. Specific labeling is also foreseen to promote the source and the use of the European Union funding.
Common organization of the markets in fishery and aquaculture products. Regulation (EU) No 1379/2013	<ul style="list-style-type: none"> • Fishery products that do not comply with common marketing standards (including minimum conservation reference sizes) may not be provided for direct human consumption. Other uses are permitted.
Common fisheries policy Council regulation (EC) No 1224/2009	<ul style="list-style-type: none"> • Introduces the specific traceability requirements applicable to fishery and aquaculture products.
Fund for European aid to the most deprived (FEAD) Regulation (EU) No 223/2014	<ul style="list-style-type: none"> • A FEAD operational program foresees the financing of food donations, whereby food is donated to a partner organization (public body or non-profit organization) free of charge. • The costs for the collection of the donated food from the donor, its transportation, storage, and distribution to the most deprived persons may be covered with FEAD funds. • Awareness-raising activities among potential food donors may also be supported.

FEAD -Fund for European aid to the most deprived; WFD - Waste framework directive; HACCP-Hazard Analysis and Critical Control Points; EU-European Union; EC-European Council

Source: Authors' elaboration; Commission notice of European Union guidelines on food donation (2017/C 361/01). Official Journal of the European Union, 25.10.2017. (also available at [https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52017XC1025\(01\)&from=PL](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52017XC1025(01)&from=PL)).

Country	Animal Feed Laws	Animal Law feed description
Japan	(0) Feed safety law - high level legislation (1) Voluntary feed ban of MBM (1996) (2) Guidelines for the prevention of Cross-contamination of feed for ruminants with ruminant proteins (2001) (3) feed ban of MBM (2001, 2005) (G) general	(1) Meat and bone meal (MBM) not to be used in ruminant feeding. (2) Rules to reduce the opportunity of contamination. (3) MBM feed ban for all livestock. Feed ban altered in 2005 to allow swine and poultry feeding to swine and poultry but not ruminants. (G) Required audits under the Food and Agricultural Materials Inspection Centre. Gelatin and collagen of mammalian origin, milk and dairy products, and eggs are approved to be consumed by ruminants and pigs.
Republic of Korea	(1) Detailed measures for improvement of livestock disease control and advanced livestock industry (2011)	(1) Measures for increasing safety for livestock: facility registration, introduction to standard operating procedures, and increased training.
United States of America	(1) Food safety modernization act (2011)- Preventative controls for animal food (Sept. 2016) (2) CFR: 589.2001 (2008) (3) CFR: 589:2000 (1997)	(1) Processing of food by-products for animal feed must comply with the CGMPs (Current good manufacturing practices), animal food processing facilities must perform a hazards analysis, implement preventative controls (with monitoring and verification), and have a recall plan if an issue arises. (2) Prohibitions of cattle materials in animal feed goal is to prevent transmission of Bovine spongiform encephalopathy (BSE). This is an update from 589.2000 (3) This version of the cattle material bans only concerned feeding cattle to ruminants.
	(1) Food safety modernization act (2011)- Preventative controls for animal food (Sept. 2016) (2) CFR: 589.2001 (2008) (3) CFR: 589:2000 (1997)	(1) Processing of food by-products for animal feed must comply with the CGMPs (Current good manufacturing practices), animal food processing facilities must perform a hazards analysis, implement preventative controls (with monitoring and verification), and have a recall plan if an issue arises. (2) Prohibitions of cattle materials in animal feed Goal is to prevent transmission of BSE. This is an update from 589.2000 (3) This version of the cattle material ban only concerned feeding cattle to ruminants.
European Union	(1) EU No 68/2013 – Catalogue of feed materials (2) EC No 183/2005-Requirements for feed hygiene (2005) (3) EC No 999/2001-Processed animal protein feed ban for all farm animals (2001) (4) Processed animal protein feed ban for cattle, sheep, and goats (1994) commission notice guidelines for the feed use of food no longer intended for human consumption (2018/C 133/02)	(1) Most recent update of catalogue defining all potential feed materials. (2) Concerns feed hygiene, feed traceability, and feed facility registration across the supply chain including imports and exports. (3) Processed animal protein feed bans for all farm animals. (4) Processed animal protein feed bans for cattle, sheep, and goats.

Note: MBM-meat and bone meal; CGMPs-current good manufacturing practices; CFR-Code of Federal regulations; BSE-bovine spongiform encephalopathy; EU-European Union; EC-European Council

Source: Authors' elaboration; Hall M. 2016. *Techno-Environmental Analysis of Generating Animal Feed from Wasted Food Products*. Thesis. Rochester Institute of Technology. New York. (also available at <https://scholarworks.rit.edu/cgi/viewcontent.cgi?article=10322&context=theses>).

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ISBN 978-92-5-136247-1



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CC0174EN/1/06.23