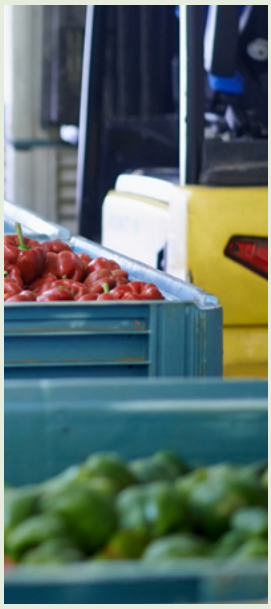
Characterization and Management of

Food Loss and Waste

in North America





Post-harvest Food Production

Food Processing

Distribution

Retail

Foodservice

White Paper

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Acknowledgments

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Abstract

Food loss and waste (FLW) is an increasingly important issue in Canada, Mexico and the United States, where close to 170 million tonnes of food produced for human consumption are lost and wasted—across the food supply chain, including in pre-harvest and consumer sectors—each year. Food waste in landfills is a significant source of methane gas—a greenhouse gas (GHG) 25 times stronger than carbon dioxide. FLW also has environmental and socio-economic impacts, including the inefficient use of natural resources, economic loss, biodiversity loss, and public health issues.

The Commission for Environmental Cooperation (CEC) established the North American Initiative on Food Waste Reduction and Recovery as part of its Green Economy and Climate Change portfolios. This white paper seeks to enhance the North American capacity to reduce disposal of food waste in the industrial, commercial and institutional (ICI) sector. It proposes comprehensive strategies to address source reduction of FLW, and for food rescue and recovery, at all stages of the food supply chain—from post-harvest food production, processing and distribution, to consumer-facing foodservice and retail sectors. Following an analysis of the current state, causes and impacts of FLW in North America, this paper identifies opportunities to reduce FLW through source reduction, and food rescue or recovery of surplus food. Estimates of FLW quantities, along with associated environmental and socio-economic impacts, are also provided. The analysis, opportunities and suggestions presented in this paper are a useful reference for the ICI sector, governments, and nongovernmental organizations (NGOs) as they develop policies, strategies and initiatives to address FLW in North America.

Executive Summary

Policies and programs on food loss and waste (FLW) are gaining momentum across North America as awareness of the issue continues to grow. The Commission for Environmental Cooperation (CEC) established the North American Initiative on Food Waste Reduction and Recovery as part of its Green Economy and Climate Change project areas.

This white paper characterizes FLW in Canada, Mexico and the United States and identifies opportunities for the industrial, commercial and institutional (ICI) sector, governments, and nongovernmental organizations (NGOs) to take action across the three countries.

The scope of this research included post-harvest to pre-consumer stages of the food supply chain (i.e., post-harvest food production; processing; distribution; retail; and food service). Pre-harvest food production and the consumer stages of the food supply chain are beyond the scope of this study. This project complements the CEC's North American Initiative on Organic Waste Diversion and Processing, which examines composting, anaerobic digestion, and other industrial processes (e.g. rendering, biofuel) for FLW and other organic waste.

The content of this white paper was compiled from primary and secondary sources of information in Canada, Mexico, the United States and countries outside of North America. Primary sources included interviews and email exchanges with 167 stakeholders representing various locations, organization types and sizes, and stages of the food supply chain. Secondary sources included reports, white papers, academic papers, news articles, media recordings and government databases, as well as a review of on-the-ground programs and projects implemented by the ICI sector, governments and NGOs. North American and international experts on the subject matter also vetted key findings during a three-day stakeholder session held in Canada, in February 2017.

Key Findings

Key findings related to FLW quantification, causes, environmental and socio-economic impacts, approaches to mitigate FLW and opportunities for action are summarized below.

Quantification

- To derive the North America–wide FLW data reported in this paper, the research team used a global FLW quantification methodology based on the United Nations Food and Agricultural Organization (FAO) estimates for food produced, by product group. Applying the FAO methodology, the estimates are as follows:
- Approximately 168 million tonnes of FLW are generated in North America each year. This estimate encompasses all stages of the food supply chain, including the pre-harvest and consumer stages. Per country, this equates to 13 million tonnes in Canada, 28 million tonnes in Mexico and 126 million tonnes in the United States. When excluding the pre-harvest and consumer stages, approximately 52 million tonnes of FLW are generated in North America each year. Per country, this estimate is equivalent to about 4 million tonnes in Canada, 15 million tonnes in Mexico and 33 million tonnes in the United States.
- When including all stages of the food supply chain, per-capita FLW in Canada is comparable to that in the United States (396 kilograms/person/year and 415 kilograms/person/year, respectively). The per-capita FLW generation in Mexico is much lower—at 249 kilograms/person/year. Nevertheless, when excluding pre-harvest and consumer stages, rates across all three countries are comparable: 110 kilograms/person/year for Canada and the United States, and 129 kilograms/person/year in Mexico.

Primary Causes

Causes of FLW across the food supply chain include:

- overproduction by processors, wholesalers and retailers;
- product damage;
- lack of cold-chain infrastructure (refrigeration during transportation and storage);
- rigid food-grading specifications;
- varying customer demand; and
- market fluctuations.

Key players such as farmers, processors, distributors, retailers, food-rescue organizations and other service providers can influence how products are moved along the food supply chain.

Environmental and Socio-Economic Impacts

The environmental and socio-economic impacts of FLW across the food supply chain are significant. Using multiple recent studies, including the FAO's *Food Wastage Footprint* (FAO 2013), the research team derived estimates of the environmental and socio-economic impacts of FLW for North America per year†:

- 193 million tonnes of greenhouse gas (GHG) emissions of carbon dioxide equivalent (CO_2e) for life-cycle of landfilled FLW;
- 17.6 billion cubic meters (m^3) of water used;
- 22.1 million hectares (ha) of cropland used;
- 3.94 million tonnes of fertilizer used;
- 13.3 x 10^{18} Joules of energy used;
- 38.6 million m^3 of space used in landfill;
- US$1,867 million spent in tipping fees;
- US$278 billion in market value of FLW lost;
- US$319 million–equivalent in loss of biodiversity; and
- 217 trillion kilocalories (kcal—1,000 calories) in potential energy lost.

Approaches

The research team used reports, interviews and conference proceedings to identify a number of approaches to FLW source reduction; food rescue and recovery; and measuring, tracking and reporting. These approaches can address causes of FLW along specific areas of the food supply chain, inform policy and education programs, and contribute to fulfilling federal government commitments. The approaches are as follows:

Source Reduction

- Reducing Portion Sizes
- Increasing Marketability of Produce
- Standardizing Date Labels
- Packaging Adjustments
- Improving Cold-Chain Management
- Value-Added Processing

† Country-specific estimates for each environmental and socio-economic impact category are set out in Table 2. The FAO categorizes United States, Canada, Australia and New Zealand as North America and Oceania region (Gustavsson et al. 2011). Mexico is grouped with Latin America, which combines the Caribbean region, Central America and South America. When country-specific information was not available, regional or global data were extrapolated to provide a basic description of the environmental and socio-economic impact of FLW in each of the North American countries.

Food Rescue and Recovery

- Increasing Rescue of Healthy Food
- Storage and Transportation Improvements
- Financial Incentives for Food Donation
- Liability Protection for Food Donors
- Online Food Rescue Platforms
- Feeding Animals

Measuring, Tracking and Reporting

- Waste Composition Analysis
- Diaries
- Surveys
- Models and Proxy Data Extrapolation

Opportunities

There are promising opportunities to develop policies, strategies and initiatives to address FLW in North America in collaboration with relevant stakeholder organizations. Some opportunities are cross-cutting, while others specifically address source reduction of food waste; food rescue and recovery; or measuring, tracking and reporting.

Cross-cutting

- Develop FLW Policies
- Foster Multi-Stakeholder Collaboration
- Create Voluntary ICI FLW Initiative
- Strengthen Regional Collaboration

Source Reduction

- Standardize Date Labels
- Update Food Grading
- Improve Cold-Chain Management
- Expand Value-Added Processing and Packaging Innovation

Food Rescue and Recovery

- Explore Food Rescue Incentives

Measuring, Tracking and Reporting

- Standardize Measuring, Tracking and Reporting
- Track and Report Performance


Organic Green Top Chiogga Beets
Organic Green Top Beets
Organic Rutabaga
Chiogga Beets
Organic Gold Beets
Organic Celery Root

Introduction

The North American Initiative on Food Loss and Waste Reduction and Recovery is a project led by the Commission for Environmental Cooperation (CEC) with support from the federal governments of Canada, Mexico and the United States. The goal of this initiative is to enhance North American capacity for reducing food loss and waste (FLW) within relevant North American industrial, commercial, and institutional (ICI) sectors across the food supply chain throughout Canada, Mexico and the United States. The scope of the current research focused on source reduction, and on food rescue and recovery, during post-harvest to pre-consumer stages of the food supply chain (i.e., post-harvest food production, processing, distribution, retail and foodservice stages). The pre-harvest food production stage and the consumer stage of the food supply chain are beyond the scope of this study.

This project is part of the climate change and green growth portfolios under the CEC's 2015–2016 Operational Plan, and supports international and domestic commitments in Canada, Mexico and the United States. It was carried out simultaneously and in conjunction with a companion CEC project entitled North American Initiative on Organic Waste Diversion and Processing, which examines composting, anaerobic digestion, and other industrial processes (e.g., rendering, biofuel) for FLW and other organic waste. Together, these two initiatives provide an overview of FLW reduction, recovery and recycling in North America.

The purpose of this white paper is to highlight the current state, causes and impacts of FLW in North America, and to identify opportunities for the ICI sector, governments and nongovernmental organizations (NGOs) to take action.

The issues and opportunities identified in this paper should be considered when developing policies, strategies and initiatives to address FLW in North America. Opportunities identified in this paper should be explored more deeply in collaboration with relevant stakeholder organizations. More details on the information and approaches presented in this paper are available in the companion foundational report, entitled *Characterization and Management of Food Loss and Waste in North America* (CEC 2017). Future work may also warrant examining FLW in pre-harvest food production and consumer stages of the food supply chain.

The content of this white paper reflects information compiled from primary and secondary sources in Canada, Mexico, the United States and various countries outside of North America. Primary sources included interviews and emails with stakeholders throughout the food supply chain, with representation distributed across location and type of stakeholder, size of organization, and stage of the food supply chain. A total of 167 interviews were conducted for this research. The interviewees' countries of origin were as follows: 46 from Canada, 78 from Mexico, 41 from the United States, and two from countries outside of North America. Secondary sources included reports, white papers, academic papers, news articles, media recordings and government databases. The literature review also included a scan of on-the-ground programs and projects implemented by the ICI sector, governments and NGOs in North America and beyond.

What is Food Loss and Waste?

Food loss refers to food that is intended for human consumption but, through poor functioning of the food production and supply system, is reduced in quantity or quality.

- Food loss is primarily due to inefficiencies in the food supply chain. Examples include food that rots in the field or in storage because of inadequate management, technology or refrigeration, or food that cannot make it to market because of poor infrastructure and thus goes unconsumed.

Food waste refers to food for human consumption that is discarded (both edible and inedible parts) due to intentional behaviors. "Food waste" often refers to what occurs along the food chain from the retail store through to the point of intended consumption.

- Food waste often occurs by choice, through poor stock management, or through neglect, and includes food that has spoiled, expired, or been left uneaten after preparation.

For the purposes of this paper, the term "food loss and waste"—or FLW—is commonly applied. Although the definitions of food loss and food waste vary, significant overlap exists between the two terms. The primary difference is that food loss tends to focus on the upstream stages of the food supply chain (i.e., food production and processing), while efforts to address food waste tend to focus on downstream stages of the food supply chain (i.e., distribution, retail, food services and consumers).

FLW can be addressed at all stages of the food supply chain through measures to enhance reduction (e.g., FLW prevention), recovery (e.g., rescuing surplus food to feed people and animals), and recycling (i.e., reducing disposal in landfills via rendering, anaerobic digestion, enhanced composting, or other means).

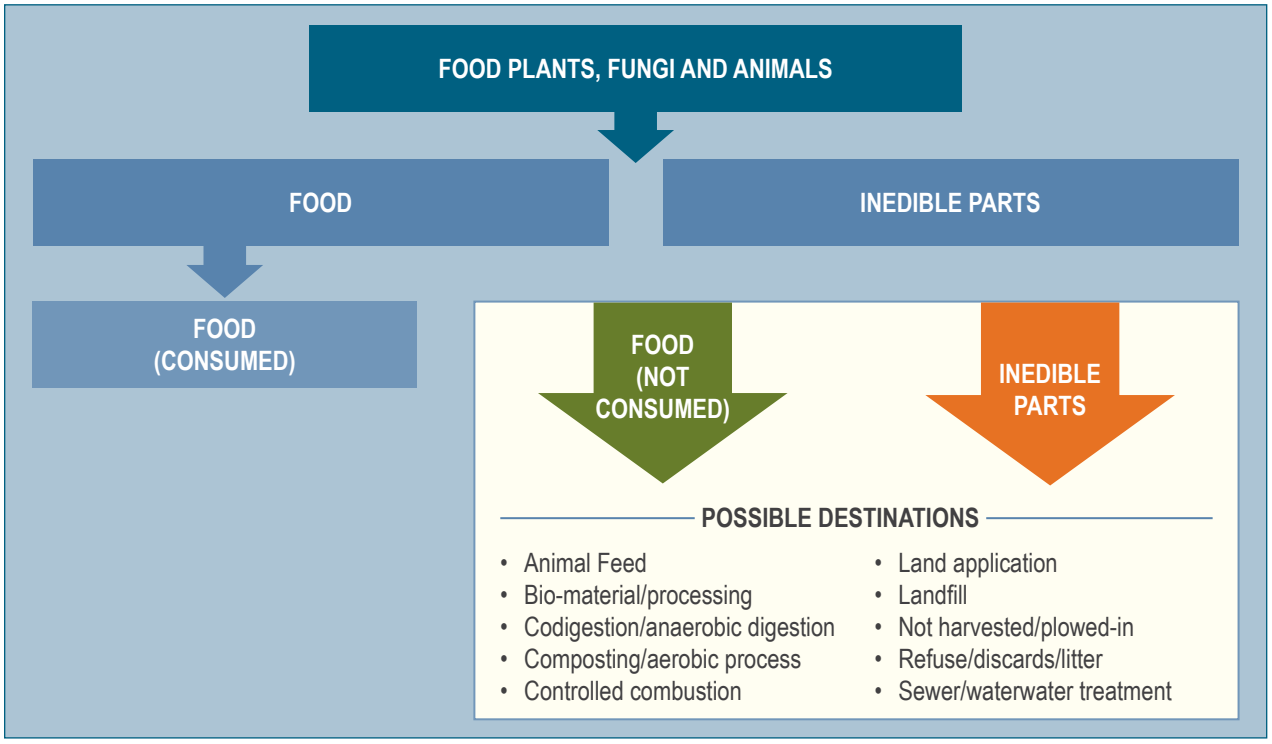
This paper differentiates edible and inedible parts of food as follows:

> **Food (edible)**: Any substance—whether processed, semi-processed or raw—that is intended for human consumption. "Food" includes drink, and any edible substance used in the manufacture, preparation or treatment of food. "Food" also includes the above material when it has spoiled and is therefore no longer fit for human consumption. It does not include cosmetics, tobacco or substances used only as drugs. It does not include processing agents used along the food supply chain—for example, water to clean or cook raw materials in factories or at home (WRI 2016, 15).

Inedible Parts (of food): Components associated with food that are not intended for human consumption in a particular food supply chain. Examples of inedible parts of food could include bones, rinds and pits/stones. "Inedible parts" does not include packaging. What is considered inedible varies among users (e.g., chicken feet are consumed in some food supply chains but not others). It also changes over time and is influenced by a range of variables, including culture, socio-economic factors, availability, price, technological advances, international trade, and geography (WRI 2016, 15).

Figure 1 demonstrates the possible destinations for unconsumed food and the inedible parts of food.

FIGURE 1. **Possible Destinations for Food and Inedible Parts**

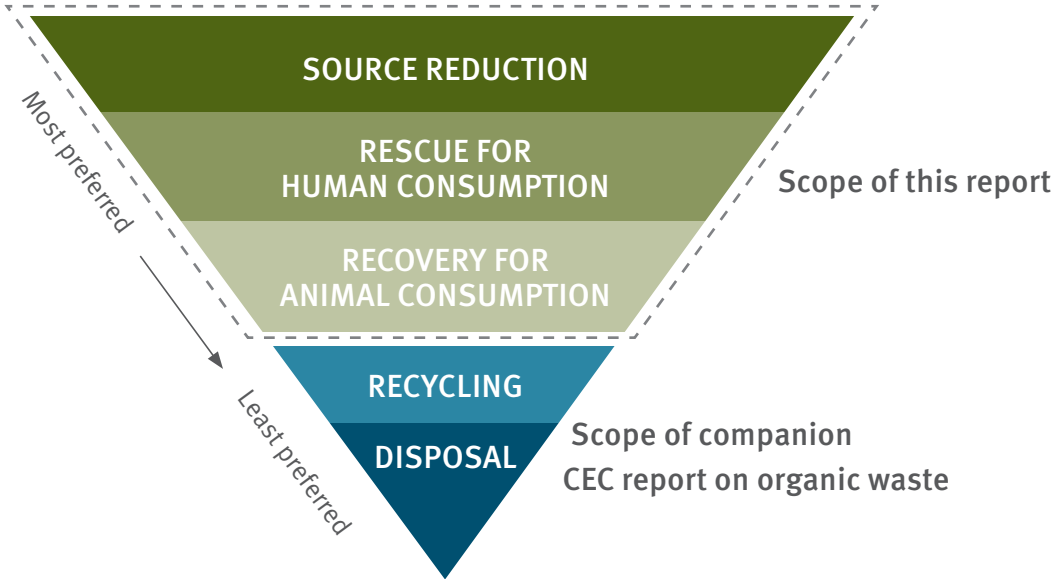


Source: Adapted from WRI 2016.

Food Recovery Hierarchy

The **food recovery hierarchy** (Figure 2) prioritizes the reduction, rescue and recovery of food over recycling and disposal. The scope of this study includes source reduction, rescue for human consumption and recovery for animal consumption.

FIGURE 2. **Food Recovery Hierarchy**



Source: Adapted from US EPA 2016a; MacRae et al. 2016; Papargyropoulou et al. 2014; Kelly 2014; WRAP 2013.

Food Recovery Hierarchy – Definitions of Terms

Source Reduction: Actions to minimize generation of surplus food and prevent avoidable generation of FLW.

Rescue for Human Consumption: Actions to rescue safe and nutritious surplus food for human consumption—receiving, storing, or processing food (with or without payment) that would otherwise be discarded or wasted. The term used in this paper to describe food that cannot be used for its originally intended purpose (e.g., sold to primary markets) but is suitable for human consumption is surplus food. Food rescued for human consumption is referred to as rescued food.

Recovery for Animal Consumption: Actions to recover safe and nutritious surplus food for animal feed—receiving, storing, or processing food (with or without payment) which would otherwise be wasted.

Recycling: Actions to recycle food for non-food-related uses—processes such as industrial processing of compounds, including fats and oils; anaerobic digestion; and composting.

Disposal: Actions to dispose of food through controlled and uncontrolled means—primarily landfilling, but also incineration, sewage, open dumping and open burning. The food recovery hierarchy does not recommend the use of uncontrolled disposal options (e.g., open dumping and open burning).

Sources: Adapted from US EPA 2016a, MacRae et al. 2016, Papargyropoulou et al. 2014, Kelly 2014, WRAP 2013.

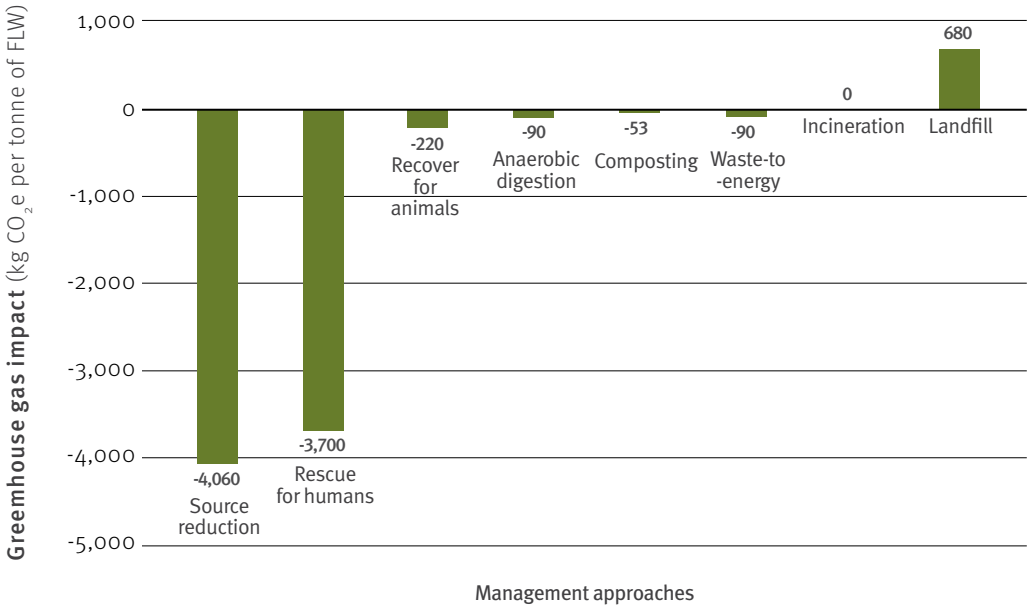
While the food recovery hierarchy provides a clarifying model for managing FLW, approaches at different tiers of the hierarchy can compete with one another, resulting in loss of benefits (Mourad 2016). For example, investing in food recycling solutions such as compost collection may disincentivize source reduction. One study found that the availability of composting programs reduced the effect of consumer education on source reduction because residents felt less guilty once food waste was composted instead of landfilled (Crane 2017).

Comparative Greenhouse Gas Savings for Food Loss and Waste

In the context of the food recovery hierarchy presented in Figure 2, source reduction and rescue for human consumption are prioritized over recovery for animal consumption, which is in turn preferable to recycling. Disposal is the least preferable option.

Source reduction has the greatest savings potential for greenhouse gas (GHG) emissions, as more than 80 percent of GHG emissions associated with FLW come from upstream sources (e.g., producing, processing, distributing food) (US EPA 2015). According to data from the Waste and Resources Action Programme (WRAP) in the United Kingdom (Figure 3), the environmental benefits of rescuing food for human consumption are far greater than those of recovering for animal consumption and therefore make rescue a higher priority. For example, WRAP (2017) estimates that the GHG emissions savings from rescuing food for human consumption are about 20 times more than those from recovering for animal consumption, and more than 40 times higher than those from recycling alternatives. In addition to the environmental benefits, rescuing food for human consumption can provide social benefits, such as support for food-insecure people in various communities.

FIGURE 3. **Greenhouse Gas Impacts of Management Approaches to Food Loss and Waste**



Note: Data collected by WRAP in 2016, for a tonne of average food waste in the United Kingdom. Includes embedded greenhouse gas emissions.
Source: Adapted from WRAP 2017.

The Food Supply Chain

This study contains a review of the food supply chain, including post-harvest stages, processing, distribution, retail and foodservice sectors, as well as secondary markets and animal feed. Figure 4 depicts a schematic of the food supply chain and highlights the sectors covered in the scope of this research, which are found within the grey, dashed outline of the rectangle. The figure simplifies the food supply chain and shows the general flow of food between the stages.

The Primary Food Supply Chain, shown in blue, tracks the typical path of food for human consumption. The stages included in the research for this paper are defined as follows:

Post-harvest Food Production covers the post-harvest activities at the farm level and those occurring outside the agricultural sector—activities that involve harvesting, handling, and storage of plants or their parts, or of animals (livestock, poultry, seafood) or their parts (adapted from Grolleaud 2001).

Food Processing is the transforming of raw foods into products suitable for consuming, cooking or storing (European Food Information Council 2016). The term "food processing" is interchangeable with "food manufacturing."

Distribution encompasses the transportation and distribution of food products before reception by the consumer, and includes wholesaling and brokering (adapted from Perner 2008).

Retail is the sale of food in businesses that serve the consumer directly (e.g., in a store or market setting), to be used in households (not sales in restaurants or institutional settings) (adapted from Suttle n.d.).

Foodservice covers preparation and serving of meals, snacks and beverages for consumption outside of the home (or for take-out), in dining or fast-food establishments and within commercial and institutional settings; e.g., restaurants, event venues, hotels and cafeterias.

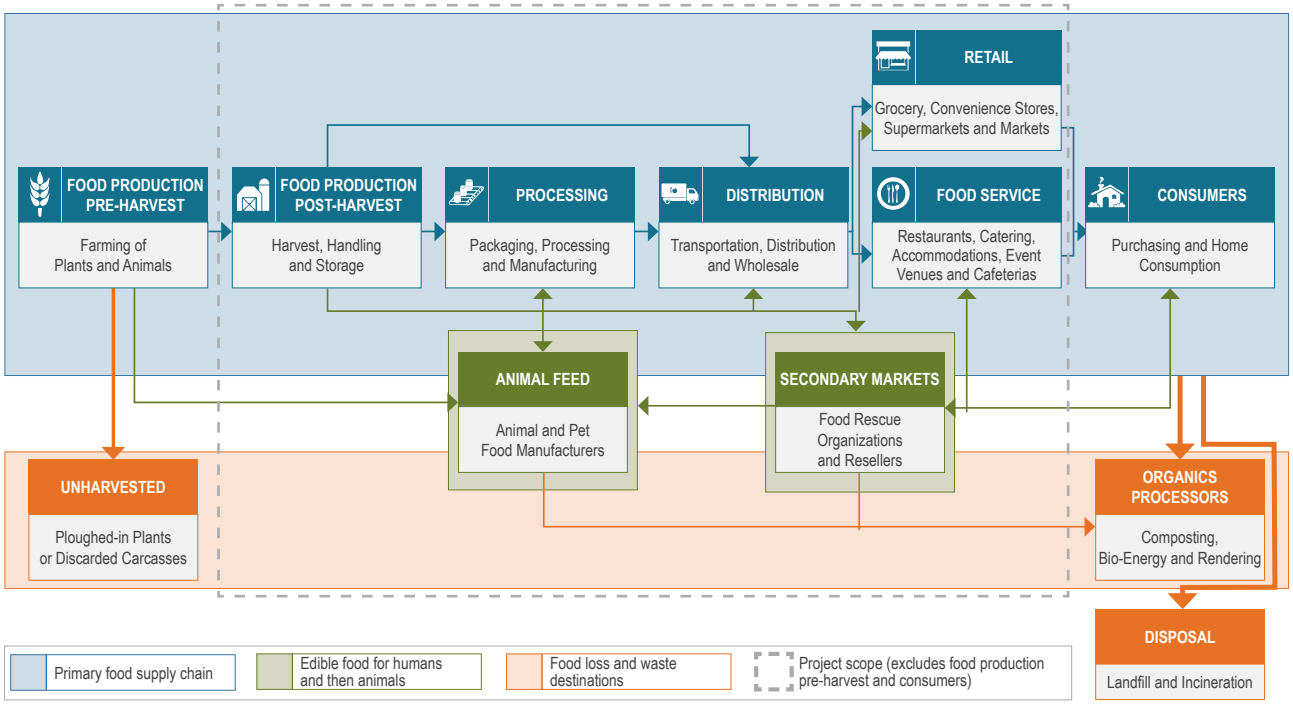
Secondary Uses covers what happens when surplus food that otherwise would go to waste is recovered for human consumption or for processing into animal feed. Secondary Uses is depicted in green.

Secondary Markets refers to customers other than those to whom the product was originally offered. The product can be a surplus of food that was generated for another market, or can be culls or byproducts of food from various points along the food supply chain. Producers, processors, and primary retailers normally sell these products at a discounted price (adapted from ReFED 2017b). Secondary markets include, but are not limited to, a range of enterprises and organizations that rescue food from the primary food supply chain and then either supply the food directly to consumers, or, more frequently, send the food to meal programs and food banks.

Animal Feed refers here to feed that has content derived from food recovered from surplus food; from wasted food that has undergone treatment and processing; and/or from animal, poultry and fish slaughter-house discard. Such feed may be mixed with other feed or be fed directly (adapted from ReFED 2017a). It is not counted here as a part of the food supply chain for humans, but is an established end-product from the diversion of food loss and waste (FLW). Animal feed is lower in the food recovery hierarchy than food rescued for human consumption.

FLW (food loss and waste) Destination refers to an end-location where the food is no longer intended for consumption. Such food includes crop that did not get harvested (or was harvested and then abandoned), crop residuals, and foodstuff that ends up being processed as waste (e.g., recycled, or disposed of). Processing food as waste is broken into two categories: organics processing and disposal. Examples are provided in a separate, companion report by the CEC, entitled *Characterization and Management of Organic Waste in North America*. FLW Destination is depicted in orange.

FIGURE 4. **Food Supply Chain Overview**



Note: Pre-harvest food production and consumer stages of the food supply chain were included for the purpose of quantifying FLW in each of the three North American countries, and estimating some environmental and socio-economic impacts.

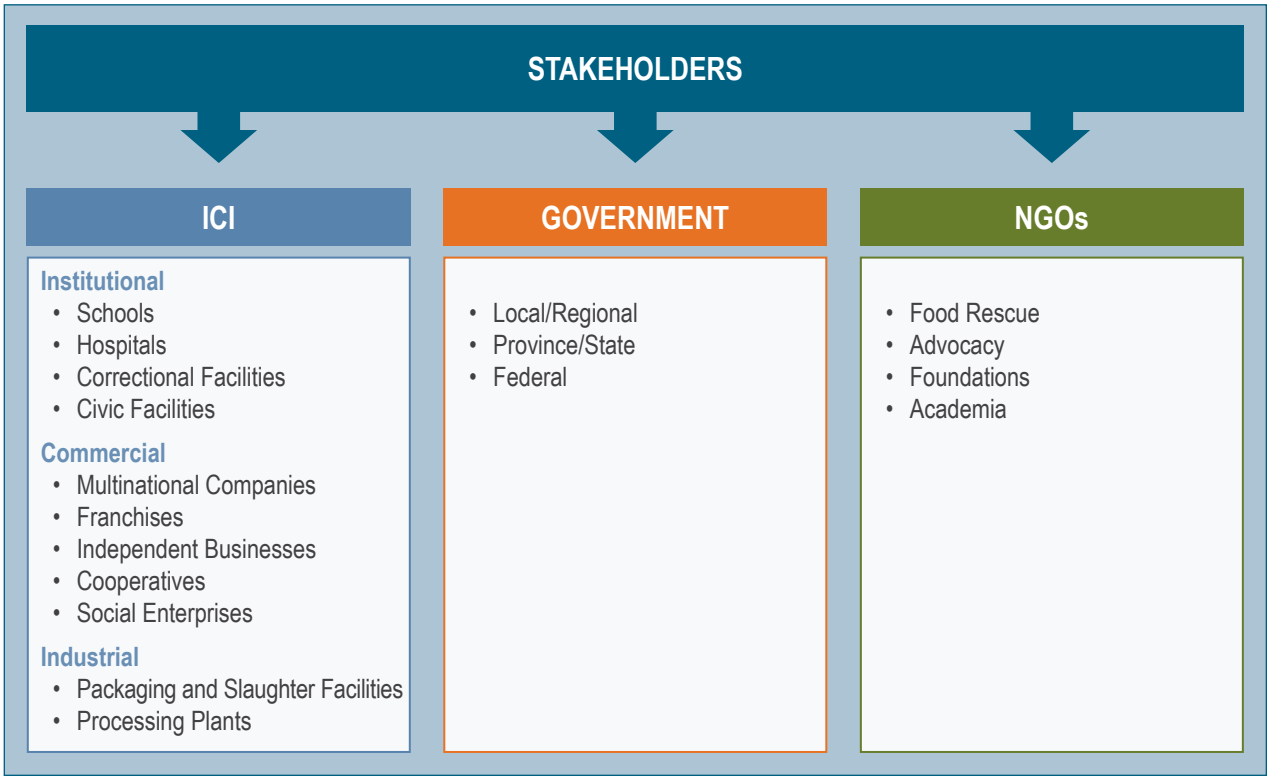
Stakeholders in the Food Supply Chain

Stakeholders are individuals or organizations that influence decisions or are affected by decisions. Associations typically represent aspects of each stakeholder group. The stakeholders in the food supply chain are defined, in the context of FLW, as follows:

- **Industrial, Commercial, and Institutional** (ICI) entities and associations are those involved in processing, preparing, preserving, distributing, and serving or selling foods and beverages. (Wiley Online Library 2016).
- **Government** includes the local, regional, state/provincial and federal departments and agencies with responsibilities related to food and FLW issues. FLW typically involves multiple government departments or agencies, such as those concerned with the environment, agriculture, public health and social development.
- **Nongovernmental Organizations** (NGOs) are typically nonprofit or voluntary groups of individuals or organizations, formed to provide services or to advocate public policy (Encyclopedia Britannica 2016). NGOs can operate on a local, regional, national or international level. NGOs include both those that work on food rescue and recovery, as well as charities that support FLW reduction initiatives; advocacy groups; and researchers, both within and outside of academia.

Figure 5 lists relevant stakeholders in the food supply chain, across the ICI, government and NGO sectors.

FIGURE 5. **Stakeholder Chart**



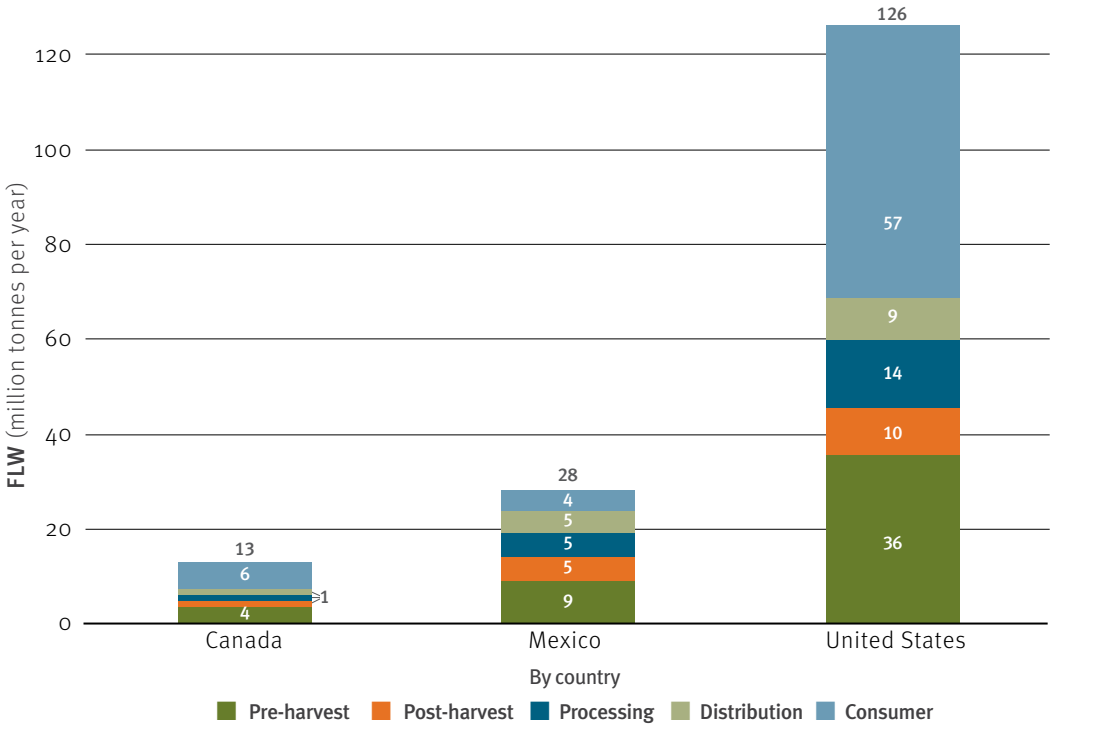
Food Loss and Waste in North America

A standard methodology for quantification of food loss and waste (FLW) in North America has not yet been developed. To present data in a consistent format for the three North American countries, the research team derived the FLW estimates below using a methodology adopted by the FAO (Gustavsson et al. 2013). In general, the scope of this research is limited to post-harvest through pre-consumer stages of the food supply chain (i.e., post-harvest food production, processing, distribution, retail and food service). Pre-harvest food production and consumer stages of the food supply chain were included for the purpose of quantifying FLW in each of the three North American countries and estimating some environmental and socio-economic impacts. Data sources are scarce and varied in this emerging area of study, so the numbers should be considered informed estimates.

Using the FAO methodology, approximately 168 million tonnes of FLW is generated in North America annually. This estimate encompasses all stages of the food supply chain, including the pre-harvest and consumer stages. By country, this equates to 13 million tonnes in Canada, 28 million tonnes in Mexico and 126 million tonnes in the United States, as presented in Figure 6. Estimates of FLW per capita across the food supply chain in North America are shown in Figure 7.

North American and Oceanic (e.g., Australia and New Zealand) countries have the highest estimated per-capita FLW globally (Gustavsson et al. 2013). Per capita, FLW in Canada (396 kg/person/year) is comparable to that in the United States (415 kg/person/year). The per-capita FLW generation in Mexico (249 kg/person/year) is much lower

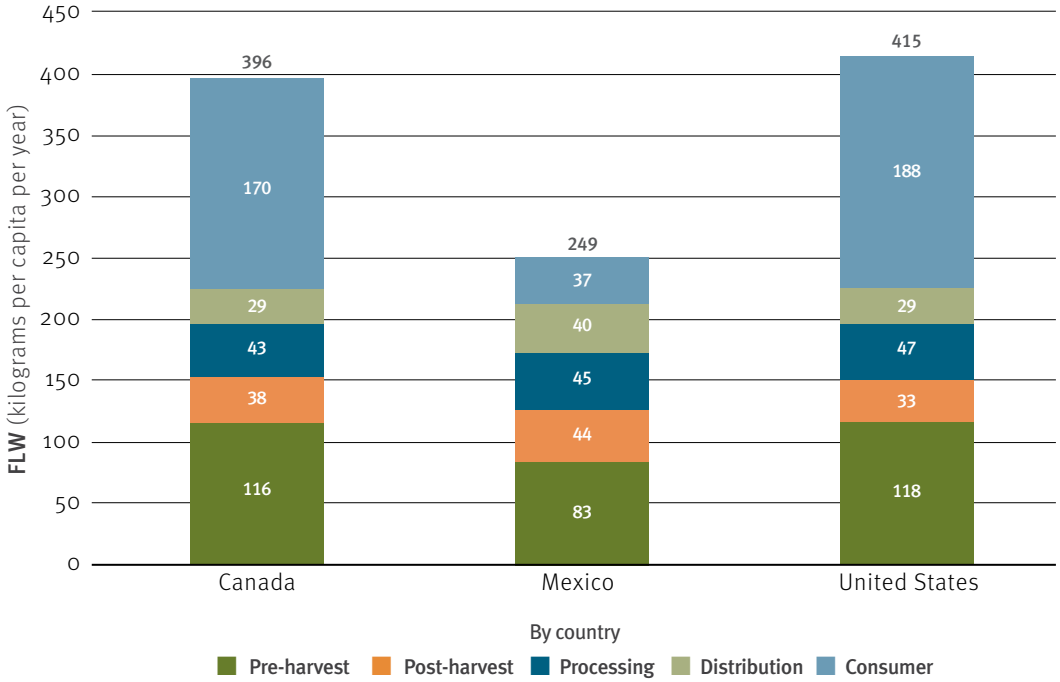
FIGURE 6. **Estimates of Food Loss and Waste across the Food Supply Chain in North America**



Note: Estimates presented in these graphs encompass all stages of the food supply chain, including the pre-harvest and consumer stages, which are otherwise excluded from the scope of this paper. FLW estimates include food (including milk) and inedible parts, based on estimates from FAO Food Balance Sheets and loss factors. FAO data include the market system in distribution (e.g., retail and foodservice).

Source: Summary of methodologies and estimates provided in the CEC foundational report *Characterization and Management of Food Loss and Waste in North America*, Section 2 and Appendix 3 (CEC 2017).

FIGURE 7. **Estimates of Food Loss and Waste Per Capita across the Food Supply Chain in North America**



Note: Estimates presented in these graphs encompass all stages of the food supply chain, including the pre-harvest and consumer stages, which are otherwise excluded from the scope of this paper. FLW estimates include food (including milk) and inedible parts, based on estimates from FAO Food Balance Sheets and loss factors. FAO data include the market system in distribution (e.g., retail and foodservice).

Source: Summary of methodologies and estimates provided in the CEC foundational report *Characterization and Management of Food Loss and Waste in North America*, Section 2 and Appendix 3 (CEC 2017).

than that in Canada or the United States. The estimates of lower FLW per capita in Mexico align with the global FAO data set, which showed that more food is generally wasted per person in medium/high-income countries (e.g., Canada and the United States) compared to low-income countries (e.g., Mexico).

There is a wide range of FLW estimates available due to variations in the scope of food supply chain stage, sector, food product type, and end-destination used in other studies of FLW in North American countries. Based on the research team's literature review and calculations reflecting population sizes (outlined in the CEC foundational report *Characterization and Management of Food Loss and Waste in North America*, Section 2 and Appendix 3), other existing estimates of FLW range from 6 to 13 million tonnes per year in Canada, 12 to 21 million tonnes per year in Mexico, and 35 to 60 million tonnes per year in the United States.[1] As stated above, these estimates of FLW quantities were derived using varying estimation parameters.

Causes of Food Loss and Waste

Table 1 presents the primary causes of FLW along different stages of the food supply chain—from post-harvest food production, to foodservice—along with the key players along the food supply chain.

1. Estimates are shown here to demonstrate that there is a range of FLW estimates available for each country. These figures may not be directly comparable. The range of estimates presented here includes the results of studies that used differing methodologies, encompassing different stages of the food supply chain. For example, the 6 million tonnes of FLW referred to for Canada is derived from a study on consumer and retail FLW, while the 13 million tonnes of FLW in Canada was derived using the FAO methodology and applies to the pre-harvest to consumer stages of the food supply chain. These studies used differing methodologies and the results are not directly comparable.

TABLE 1. **Causes of Food Loss and Waste, and Key Players that Can Address Them**

Post-Harvest

Processing

Distribution

Retail

Foodservice

Causes of Food Loss and Waste

Post-Harvest	Processing	Distribution	Retail	Foodservice
▪ Grading standards for size and quality ▪ Inaccurate supply-and-demand forecasting ▪ Order cancellations ▪ Employee behavior ▪ Low market prices and lack of markets (especially for second-grade products) ▪ Inadequate sorting ▪ Damage from handling ▪ Spillage and degradation ▪ Inappropriate transportation and storage conditions ▪ Cold-chain (refrigeration during transportation and storage) deficiencies ▪ Labor shortages	▪ Inadequate infrastructure, machinery ▪ Inefficient systems design ▪ Damage during production ▪ Inaccurate supply-and-demand forecasting ▪ Contamination ▪ Trimming and culling ▪ Supply/demand issues ▪ Inconsistent/confusing date labels ▪ Inconsistency in quality of ingredients ▪ Food safety issues ▪ Production line changes ▪ Cold-chain deficiencies ▪ Facility employee behavior	▪ Damage during transport ▪ Inaccurate supply-and-demand forecasting ▪ Cold-chain deficiencies ▪ Rejection of shipments ▪ Poor record keeping ▪ Inappropriate transportation and storage conditions ▪ Incorrect/ineffective packaging ▪ Delays during border inspections ▪ Road infrastructure challenges ▪ Excessive food distribution centralization	▪ Inaccurate supply-and-demand forecasting ▪ Overstocking ▪ Food safety concerns ▪ Inconsistent/confusing date labels ▪ Order minimums and fluctuations in delivery from suppliers ▪ Cold-chain deficiencies ▪ Rejection of shipments ▪ Increasing merchandising standards ▪ Product differentiation ▪ Market over-saturation ▪ Rigid management ▪ Marketing practices	▪ Plate composition ▪ Expansive menu options ▪ Over-serving ▪ Over-preparing ▪ Unexpected demand fluctuations ▪ Preparation mistakes ▪ Improper handling and storage ▪ Rigid management ▪ Facility employee behavior ▪ Food safety concerns ▪ Use of trays ▪ Marketing practices

Key Players That Can Address Causes

Post-Harvest	Processing	Distribution	Retail	Foodservice
▪ Farm owners ▪ Farm workers ▪ Retailers ▪ Processors ▪ Distributors ▪ Food rescue organizations ▪ Service providers (storage, equipment) ▪ Government (various levels)	▪ Facility managers ▪ Facility employees ▪ Retailers ▪ Distributors ▪ Service providers (equipment, process engineers) ▪ Food rescue organizations ▪ Government (various levels)	▪ Facility managers ▪ Farm owners/workers ▪ Facility employees ▪ Service providers (equipment, transport, packaging) ▪ Processors ▪ Retailers and intermediaries ▪ Foodservice ▪ Food rescue organizations ▪ Government (various levels)	▪ Facility managers ▪ Facility employees ▪ Farm owners ▪ Processors ▪ Distributors ▪ Service providers (packaging, technology) ▪ Food rescue organizations ▪ Government (various levels)	▪ Facility owners and managers ▪ Facility employees ▪ Service providers (custodial, delivery, food service) ▪ Distributors ▪ Food rescue organizations ▪ Government (various levels)

Sources: Adapted from Provision Coalition 2014, Blair and Sobal 2006, ReFED 2016, Lipinski et al. 2013, Gunders 2012, Parfitt et al. 2010, and Gustavsson et al. 2011.

Environmental and Socio-Economic Impacts

Across the food supply chain, FLW contributes to significant environmental and socio-economic impacts associated with the following:

- greenhouse gas (GHG) emissions;
- water use;
- land use;
- fertilizer use;
- energy use;
- wasted landfill space and tipping fees;
- market value of FLW;
- loss of biodiversity; and
- wasted calories.

Table 2 presents estimates of the environmental and socio-economic impacts from FLW, per country, in North America. Figure 8 displays the total estimates for North America. Due to limited data on these impacts in each North American country, the research team used regional or global data when country-specific information was unavailable. Furthermore, detailed and accurate quantification of FLW is still in the early stages of development; thus, applying methodologies and tools to quantify environmental and socio-economic impacts includes significant levels of uncertainty.

TABLE 2. **Environmental and Socio-Economic Impacts of Food Loss and Waste**

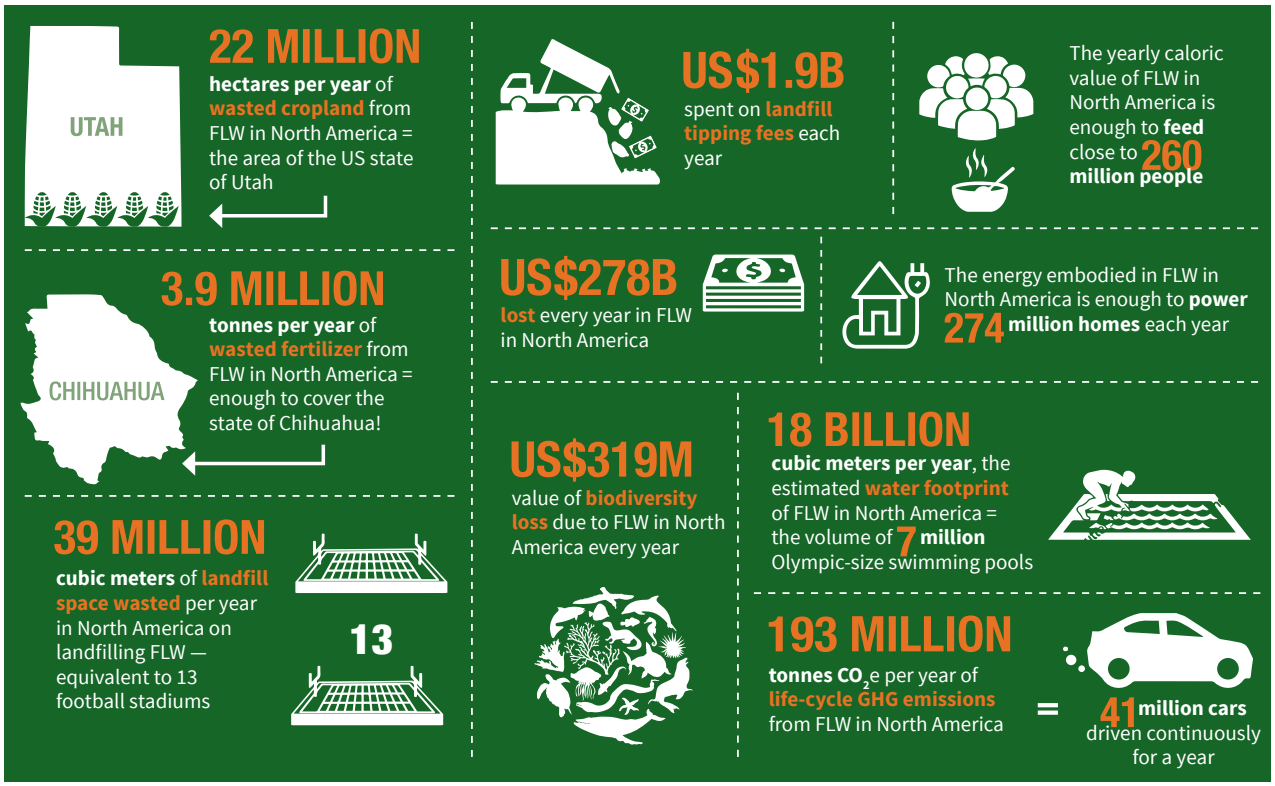
Impact Category[1]	Unit	Canada	Mexico	United States	North America
Life-Cycle Greenhouse Gas Emissions for Landfilled FLW[2,a]	million tonnes CO_2e per year	21[a]	49[b]	123[b]	193
Water Use[3,c]	billion m^3 per year	1.5	2.7	13.4	17.6
Wasted Cropland[3,c]	million ha per year	1.8	4.4	15.9	22.1
Fertilizer Use[3,c]	million tonnes per year	0.33	0.63	2.97	3.94
Biodiversity Loss[3,d]	loss equivalent to X million US$ per year	26	64	229	319
Energy Use[3,e]	10^{18} Joules per year	1.0	3.4	8.9	13.3
Wasted Landfill Space[2,f]	million m^3 per year	4.2	8.6	25.9	38.6
FLW Tipping Fees[2,f]	million US$ per year	326	249	1,293	1,867
Market Value of FLW[3]	billion US$ per year	24[g]	36[h]	218[i]	278
Wasted Calories[3,j]	trillion kcal per year	20	20	177	217

1. Assumptions and parameters for quantifying environmental and socio-economic impacts are provided in the CEC foundational report *Characterization and Management of Food Loss and Waste in North America*, Section 6 and Appendices 4 and 6 (CEC 2017).
2. Life-cycle greenhouse gas emissions, wasted landfill space and wasted tipping fees were only calculated for landfilled FLW; the estimates exclude FLW disposed of, unharvested, or lost by other means.
3. While not explicitly stated in each methodology, estimates assume FLW from all stages of the food supply chain are included. Estimates shown only include the direct cost (market value) of FLW. Indirect costs such as labor, transportation, storage and wasted resources are not included.

Note: CO_2e = carbon dioxide equivalent; m^3 = cubic meters; ha = hectare; kcal = kilocalories.

Sources: **a.** ICF Consulting 2005, US EPA 2015; **b.** US EPA 2015; **c.** Kummu et al. 2012; d. FAO 2014; **e.** Cuellar and Webber 2010; **f.** Green Power Inc. 2014, EPA Victoria 2016; **g.** Gooch et al. 2014; **h.** Gutiérrez Aguilar 2016; **i.** ReFED 2016; **j.** Lipinski et al. 2013.

FIGURE 8. **Environmental and Socio-Economic Impacts in North America**



Note: Due to limited data on the environmental and socio-economic impacts of FLW in each North American country, regional or global data were used when country-specific information was unavailable. The estimates represent totals for the three North American countries combined.

Government Programs and Commitments on Food Loss and Waste in North America

One of the specific targets of the United Nations' Agenda 2030 on Sustainable Development is to: "halve per capita global food waste at the retail and consumer level, and reduce food losses along production and supply chains by 2030" (UN 2015). North America has implemented regional programs and commitments addressing FLW across all three countries; Canada, Mexico and the US have implemented similar initiatives on a national scale. These programs and commitments—presented in Table 3—are cross-cutting between FLW source reduction; food rescue and recovery; and measuring, tracking and reporting.

TABLE 3. **Government Programs and Commitments to Address Food Loss and Waste in North America**

Country/Region	Programs and Commitments
North America	▪ North American Climate, Clean Energy, and Environment Partnership Action Plan ▪ North American Initiative on Food Loss and Waste Reduction and Recovery
Canada	▪ Strategy on Short-lived Climate Pollutants
Mexico	▪ National Strategy and Program of Sustainable Production and Consumption ▪ National Crusade Against Hunger ▪ Champions 12.3 Initiative
United States	▪ FLW Target (reduce by 50% by 2030) ▪ Food Recovery Challenge ▪ FLW 2030 Champions

Approaches to Addressing Food Loss and Waste

The following sub-sections provide an overview of stakeholder approaches across North America for FLW source reduction; food rescue and recovery; and measuring, tracking and reporting; in addition to a description of the resulting benefits. These approaches can help fulfill the commitments made by the North American governments and organizations listed in Table 3. The approaches are based on CEC research conducted for the foundational report *Characterization and Management of Food Loss and Waste in North America*, which includes a detailed overview of trends, challenges and examples for each North American country (CEC 2017).

Potential Stakeholder Benefits from Reducing Food Loss and Waste

Investing in and implementing approaches for FLW source reduction; food rescue and recovery; and measuring, tracking and reporting has the potential to produce a range of benefits for stakeholders across the food supply chain. These benefits are summarized in Table 4.

TABLE 4. **Potential Benefits from Addressing Food Loss and Waste**

	Type of Approach		
Stakeholder	**Reduction**	**Rescue and Recovery**	**Measuring, Tracking and Reporting**
ICI	▪ Increase sales and revenue from untapped markets ▪ Operational efficiencies and savings ▪ Positive brand recognition ▪ Corporate social responsibility ▪ Potential job creation ▪ Reduce pollution and greenhouse gas emissions	▪ Mitigate costs of disposal ▪ Positive brand recognition ▪ Increase employee morale ▪ Corporate social responsibility ▪ Reduce pollution and greenhouse gas emissions	▪ Identify root causes of FLW ▪ Use data to drive change and develop FLW solutions ▪ Track employee and operational performance ▪ Employee engagement
Government	▪ Conserve natural resources ▪ Mitigate habitat loss ▪ Reduce pollution and greenhouse gas emissions ▪ Mitigate disposal costs ▪ Optimize infrastructure/utilities to support food production, processing and distribution	▪ Conserve natural resources ▪ Mitigate habitat loss ▪ Reduce pollution and greenhouse gas emissions ▪ Lower costs for waste management ▪ Augment social programs for food assistance and ensure food security	▪ Measure, track and evaluate progress on FLW targets or goals ▪ Use data to develop FLW policies ▪ Increase accountability on meeting FLW commitments
NGO	▪ Achieve organizational mandates for environmental and/or social impacts	▪ Achieve organizational mandates for environmental and/or social impacts ▪ Reduce food procurement costs (for food rescue only) ▪ Increase quality of food ▪ Improve supply management	▪ Provide evidence base for advocacy efforts on FLW ▪ Evaluate effectiveness of solutions

Source Reduction of Food Loss and Waste

Table 5 presents approaches to FLW source reduction. Each approach includes a description, causes of FLW addressed, and stages of the food supply chain involved. Stages that are more directly involved are indicated in bold. These initiatives were identified across multiple literature sources, as well as by key stakeholders (e.g., academia, different levels of government, ICI associations, foodservice, NGOs) throughout the food supply chain, as promising solutions.

TABLE 5. **Approaches to Source Reduction of Food Loss and Waste**

Approach	Description	Causes of FLW Addressed by Approach	Stages of Food Supply Chain Involved*
1 **Reducing Portion Sizes**	In foodservice settings, reducing portion sizes as a way to reduce plate waste, either through serving smaller portions or making operational changes that encourage customers to take less food.	▪ Over-preparing ▪ Over-serving ▪ Plate composition ▪ Use of trays	▪ **Foodservice**
2 **Increasing Marketability of Produce**	Accepting and integrating second-grade produce into retail settings, typically sold at a discounted rate.	▪ Grading requirements for size and quality as set by retail and/or government ▪ Inaccurate forecasting of supply and demand ▪ Increasing merchandising standards ▪ Rejection of shipments	▪ **Post-Harvest** ▪ Processing ▪ Distribution ▪ **Retail** ▪ Foodservice
3 **Standardizing Date Labels**	Collaborating among stakeholders to standardize date labels so they are clear and consistent, to reduce confusion at all stages of the food supply chain.	▪ Inaccurate forecasting of supply and demand ▪ Inconsistent/confusing date labels ▪ Food safety concerns	▪ **Processing** ▪ **Distribution** ▪ **Retail** ▪ Foodservice
4 **Implementing Packaging Adjustments**	Collaborating among processors, packagers, retail and foodservice to improve shelf-life, using both packaging and sizing (e.g., flexible pack sizes to meet customer demands) and technology (e.g., intelligent packaging).	▪ Damage during transport ▪ Inconsistent/confusing date labels ▪ Cold-chain deficiencies ▪ Food safety concerns ▪ Over-purchasing	▪ Post-Harvest ▪ **Processing** ▪ **Distribution** ▪ **Retail** ▪ Foodservice
5 **Improving Cold-Chain Management**	Improving or upgrading infrastructure such as trucks, cold rooms and warehouses to maintain appropriate food temperatures during transportation.	▪ Rejection of shipments due to spoilage ▪ Cold-chain deficiencies ▪ Inappropriate storage conditions (e.g., temperature not regulated or does not meet sanitary standards)	▪ **Post-Harvest** ▪ Processing ▪ **Distribution** ▪ **Retail** ▪ Foodservice
6 **Expanding Value-Added Processing**	Extending the usable life of food through processing into shelf-stable products, including processing byproducts into food products through innovative technologies.	▪ Low market prices and lack of markets for second-grade products ▪ Damage from handling ▪ Inaccurate forecasting of supply and demand ▪ Cold-chain deficiencies ▪ Trimming and culling	▪ Post-Harvest ▪ **Processing**

* Stages that are more directly involved are in bold.

Food Rescue and Recovery

Table 6 presents approaches to food rescue and recovery. Each approach includes a description, causes of FLW that the approach helps to overcome, and the stages of the food supply chain involved. Stages that are more directly involved are indicated in **bold**. These initiatives were identified across multiple literature sources, as well as by key stakeholders (e.g., academia, different levels of government, ICI associations, foodservice, NGOs) throughout the food supply chain, as promising solutions.

Table 6. Approaches to Food Rescue and Recovery

Approach	Description	Causes of FLW Addressed by Approach	Stages of Food Supply Chain Involved*
1 **Increasing Rescue of Healthy Food**	Supporting food banks, gleaning-organizations (they harvest remaining crops in the field), food-rescuing hubs, and meal programs rescuing surplus food: to increase access to nutritious food for food-insecure people.	▪ Grading standards for size and quality ▪ Inaccurate forecasting of supply and demand ▪ Unexpected fluctuations in demand ▪ Overstocking	▪ **Post-Harvest** ▪ **Processing** ▪ **Distribution** ▪ Retail ▪ Foodservice
2 **Implementing Storage and Transportation Improvements**	Expanding temperature-controlled food distribution and storage infrastructure for donated food.	▪ Cold-chain deficiencies ▪ Improper handling and storage	▪ Post-Harvest ▪ Processing ▪ **Distribution** ▪ Retail ▪ Foodservice
3 **Exploring Financial Incentives for Food Donation**	Exploring federal tax incentives for corporations to make food donations, to encourage such donations and educate potential donors on policies.	▪ Low market prices and lack of markets for second-grade and surplus food products	▪ **Post-Harvest** ▪ **Processing** ▪ **Distribution** ▪ Retail ▪ Foodservice
4 **Developing Liability Protection for Food Donors**	Enacting regulations that protect donors from liability for donated food; educating potential donors on existing regulations.	▪ Food safety concerns	▪ Post-Harvest ▪ Processing ▪ Distribution ▪ Retail ▪ Foodservice
5 **Supporting Online Food Rescue Platforms**	Developing online platforms/organizations that support matching of generators of surplus foods to buyers or organizations willing to take donations.	▪ Low market prices and lack of markets for second-grade products ▪ Inaccurate supply and demand forecasting	▪ Post-Harvest ▪ Processing ▪ Distribution ▪ Retail ▪ Foodservice
6 **Feeding Animals**	Processing surplus food or food byproducts into animal feed or pet food, or feeding it to animals directly.	▪ Inaccurate supply and demand forecasting ▪ Low market prices and lack of markets for second-grade products ▪ Damage from handling ▪ Trimming and culling	▪ **Post-Harvest** ▪ **Processing** ▪ Retail ▪ Foodservice

* Stages that are more directly involved are in bold.

Measuring, Tracking and Reporting

Table 7 outlines a variety of methods commonly used to quantify FLW according to the *Food Loss and Waste Accounting and Reporting Standard* (WRI 2016). The approaches apply to all stages of the food supply chain.

TABLE 7. **Methods of Quantifying Food Loss and Waste**

Category	Method	Definition
Measurement or Approximation Requires direct access to FLW	Direct Weighing	Using a measuring device to determine the weight of FLW.
	Counting	Assessing the number of items that make up FLW and using the result to determine the weight; includes using scanner data and "visual scales."
	Assessing Volume	Assessing the physical space occupied by FLW and using the result to determine the weight.
	Waste Composition Analysis	Physically sorting FLW from other material to determine weight and composition; includes direct weighing, counting, or assessing volume, to obtain metrics to calculate or infer composition.
	Records	Using routinely recorded data that are collected for reasons other than quantifying FLW (e.g., waste-water transfer receipts, or warehouse record books). Records may be used as proxy data or integrated as part of survey data.
	Diaries	Maintaining a daily record or log of FLW and other information (e.g., paper or electronic diary kept in kitchen). This approach includes direct weighing, counting, or assessing volume, to obtain data for daily logs.
	Surveys	Gathering data on FLW quantities, or gathering other information (e.g., attitudes, beliefs, self-reported behaviors), from a large number of individuals or entities, through a set of structured questions.
Measurement or Approximation Requires direct access to FLW	Mass Balance	Measuring inputs (e.g., ingredients at a factory site, grain going into a silo) and outputs (e.g., products made, grain shipped to market), alongside changes in levels of stock and changes to the weight of food during processing. This is considered to be one type of model (see below).
	Modeling	Using a mathematical approach based on the understood interaction of multiple factors and processes that influence the generation of FLW.
	Proxy Data	Using FLW data that are outside the scope of an entity's FLW inventory (e.g., older data, FLW data from another country or company) to infer quantities of FLW within the scope of the entity's inventory. Proxy data are generally used as part of a modeling exercise or may be requested in surveys.

Source: WRI 2016.

Examples of Policies and Education/Awareness Programs

The approaches described in previous sections can support or be supported by existing policies and education/awareness programs. Figure 9 presents examples of policies and education/awareness programs, at local to regional levels, with organization, sector type, and country indicated for each.

FIGURE 9. **Examples of Policies and Education/Awareness Programs on Source Reduction of Food Loss and Waste in North America**

Opportunities

This section provides an overview of opportunities to enhance FLW initiatives in North America. The areas of opportunity, and factors involved when considering them, are outlined as follows:

- Country-specific Implementation: Factors such as where the greatest FLW occurs, cultural context, and economic impacts vary by country. Country-specific variations such as geography, demographics, government priorities, available resources, and stakeholder involvement should be taken into consideration in the development of implementation plans.
- Stakeholder Engagement: Individual stakeholder needs and interactions affecting FLW are important considerations. Stakeholders from across the supply chain need to be engaged, in order to increase buy-in and commitment to FLW initiatives and to positively influence the effectiveness of solutions.
- Systemic Changes: FLW is a complex and systemic problem. Implementation of opportunities should be systems-based and holistic. Identifying beneficial leverage points is key to changing the mindset, rules and structure of the prevailing food system. The goal is to shift existing paradigms involving FLW, in order to create sustainable change.
- Dynamic Execution: The food system is dynamic, unpredictable and continually evolving. Unexpected conditions or unintended consequences may surface during implementation. Therefore, piloting and testing ideas before implementing them full-scale can help to mitigate risks. Plans and approaches can be fine-tuned by using data collected and outcomes observed during an experimental phase.

Country-specific Considerations

In addition to the regional considerations for the opportunities noted above, the following sub-sections present country-specific considerations.

Canada

There are several factors to consider when implementing FLW-related opportunities within Canada. Canada's population is primarily concentrated along the southern border (Statistics Canada 2011). Other parts of the country generally consist of rural areas, with some scattered metropolitan regions across the northern parts of provinces and territories (Statistics Canada 2011). Due to this population distribution, food is often transported over great distances from rural areas (where most food is grown) to urban regions along the southern border. This is an important consideration when selecting interventions, since initiatives effective in more densely populated regions (e.g., Europe) may not work as well in sparsely populated regions of Canada.

In addition, Canada imports and exports a considerable amount of food, which adds complexity to the food supply chain. In 2015, Canada had US$33 billion of agri-food imports and US$41 billion of exports (Agriculture and Agri-Food Canada 2016). Furthermore, different aspects of the food supply chain involve municipal, provincial and/or federal governance, presenting challenges and opportunities for interjurisdictional and intergovernmental coordination. An emerging group of NGOs continues to advocate for FLW-related policy and program initiatives, creating momentum that can be further optimized as governmental bodies prioritize action on this issue.

Mexico

Most of FLW in Mexico occurs in the upstream stages of the food supply chain, and although the scope of this report focuses on the stages of the food supply chain from post-harvest to retail, it was clear that pre-harvest activities are influenced by various activities in the ICI-production and consumption stages, and vice versa.

Therefore, existing and additional opportunities to integrate FLW initiatives into ICI-sector operations should be explored and implemented. Opportunities in the ICI sector also support one of the five goals of the National Crusade against Hunger—to minimize post-harvest FLW, which includes during the storage, transportation, distribution and commercialization stages of the food supply chain (DOF 2013).

Further, since agricultural production is the primary activity that contributes to biodiversity loss due to changes to natural habitats (FAO 2013), and since the conservation and sustainable use of biodiversity is a leading policy focus in Mexico, the link between FLW and biodiversity loss should be considered when developing FLW strategies. The synergy between these environmental and social goals presents an opportunity to jointly move both the FLW agenda and the National Crusade against Hunger forward.

United States

As identified throughout the report, the US government announced a national FLW reduction goal and recently released a call to action (US EPA 2016b); other key initiatives are underway across multiple levels of government and within the private sector. Given that FLW is already an elevated topic—at least within companies and agencies working in the food sector—there are opportunities and challenges pertaining to the coordination of various initiatives already underway. These opportunities may help harmonize and build upon existing initiatives, as key stakeholder groups continue to come together and the public is increasingly aware of and engaged in addressing FLW. For example, in response to the proliferation of initiatives and support materials, the multi-stakeholder initiative "Further With Food" seeks to pull together and share high-quality information from various stakeholders about proven solutions and innovative new approaches to reducing food loss and waste. Information resources are submitted to "Further With Food" and then compiled onto the organization's searchable, user-friendly website (Further With Food 2013).

Cross-cutting Opportunities

Tables 8 to 11 present opportunities to address FLW. All opportunities listed apply to Canada, Mexico and the United States. Table 8 examines cross-cutting opportunities that apply across all stages of the food supply chain (agriculture, manufacturing, distribution, retail and foodservice): FLW source reduction; food rescue and recovery; and measuring, tracking and reporting. The opportunities apply across all stages of the food supply chain unless otherwise noted. Tables 9 to 11 focus on specific opportunities to target source reduction, rescue and recovery, and measuring, tracking and reporting. Each opportunity includes a brief description, implementation considerations, and stakeholders involved.

TABLE 8. **Cross-cutting Opportunities**

Opportunity	Description	Considerations	Stakeholders Involved
Develop FLW Policies	Establish and/or reinforce policies that address FLW, either as stand-alone initiatives or as components of other policies (e.g., national food policy, hunger relief, calls-to-action, zero waste) at national, provincial/state and municipal levels of government.	▪ Align FLW reduction targets for the retail and consumer levels with Target 12.3 of the United Nations' Sustainability Development Goals (SDGs): to reduce FLW from retail and consumer levels by 50% by 2030 and significantly reduce FLW from other parts of the food supply chain (UN 2015). ▪ Integrate feedback from departments at different levels of government and from the broader FLW stakeholder base. ▪ Include guidance on how to most effectively measure, track and report progress on goals, where relevant.	▪ ICI: Companies, associations ▪ Government: Environmental, agricultural, food, health agencies ▪ NGOs: Advocacy, food rescue
Foster Multi-Stakeholder Collaboration	Develop and/or expand upon multi-stakeholder partnerships or agreements for collaboration on implementing FLW initiatives and research in each country, as well as among the North American countries.	▪ Include key global partners (e.g., Champions 12.3) in North America–wide collaboration to address globalization of the ICI sector. ▪ Initialize implementation of FLW projects with an NGO or leading association, then expand to a broader set of stakeholders. ▪ Measuring, tracking and reporting on progress is important for evaluating the impact of initiatives and enabling improvements to use resources in the most effective way. ▪ Pool funding and in-kind resources to provide technical assistance to the ICI sector on FLW source reduction; food rescue and recovery; and measuring, tracking and reporting. ▪ Share data, case studies, lessons learned, updates on initiatives, research, and training resources, on an online platform.	▪ ICI: Companies, associations ▪ Government: Environmental, agricultural, food, health agencies ▪ NGOs: Advocacy, academia, foundations, food rescue
Create Voluntary ICI FLW Initiatives	Establish and/or reinforce voluntary agreements, FLW reduction targets or calls-to-action, to encourage ICI stakeholders to commit to taking action on FLW.	▪ Identify national organizations or agencies to spearhead and/or augment existing initiatives, along with establishing funding and timelines. ▪ Reinforce existing voluntary ICI FLW initiatives. ▪ Provide technical assistance (e.g., fact sheets, webinars), workshops and guidebooks, to help ICI stakeholders identify where FLW occurs and opportunities to avoid FLW. ▪ Leverage practices in multi-national companies and associations, to harmonize measuring, tracking and reporting on the progress of ICI-led FLW initiatives across the three countries.	▪ ICI: Companies, associations ▪ NGOs: Advocacy, foundations ▪ Government, including municipal, provincial/state and federal levels (legislative and executive): environmental, agricultural, food and health agencies
Strengthen Regional Collaboration	Form a North American advisory committee with a focus on FLW.	▪ Continue monitoring trilateral progress on FLW by engaging key federal government and other stakeholders on a regular basis. ▪ Pursue additional studies on FLW in the two other key parts of the food supply chain—farm production and consumers—or other priority needs identified in this report. ▪ Support community-led initiatives for FLW avoidance, through instruments such as the North American Partnership for Environmental Community Action (NAPECA) grants. ▪ Sponsor conferences to convene key stakeholders from the three North American countries on a regular basis.	▪ Government: Environmental, agricultural, food, health agencies

Source Reduction of Food Loss and Waste

Table 9 outlines opportunities for source reduction of FLW along with considerations for implementation. The opportunities apply across all stages of the food supply chain unless otherwise noted.

TABLE 9. **Opportunities for Source Reduction of Food Loss and Waste**

Opportunity	Description	Considerations	Stakeholders Involved
Standardize Date Labels	Establish a guideline that standardizes date labels across the North American countries.	▪ Partner with industry, government and NGOs to develop and reinforce standard date labeling. ▪ Develop educational programs to raise awareness and competency on interpreting date labels and applying the standards, across the food chain. ▪ Review existing food labeling policies and mandates, to determine how best to balance food safety with FLW reduction.	▪ ICI: Associations; processing, distribution and retail companies ▪ Government: Agriculture and food agencies ▪ NGOs: Food rescue, advocacy
Reform Food Grading	Change cosmetic requirements for food grading to categorize more food as acceptable for primary markets, and harmonize grading guidelines across the North American countries.	▪ Evaluate the effect on import/exports and optimizing food usage. ▪ Provide education across the food supply chain—particularly at the retail level, where food grading is more stringent than legislation requires. ▪ Promote use of second-grade produce, through awareness and educational campaigns in the ICI sector, especially for retail and foodservice stakeholders. ▪ Create/promote secondary markets.	▪ ICI: Food producers, retail companies, and associations ▪ Government: Food and agricultural agencies ▪ NGOs: Food rescue and advocacy
Improve Cold-Chain Management	Improve cold-chain management by using appropriate vehicles and storage facilities to minimize FLW.	▪ Pool funding and in-kind resources, to provide technical support to reinforce best practices in cold-chain management and for financing to upgrade equipment, especially for small and medium-size enterprises with limited capital resources for upgrades. ▪ Develop clearer and more efficient protocols for border/customs staff, to prevent FLW from being created by delays in food inspections at border crossings.	▪ ICI: Companies and associations ▪ Government: Food, transport, border and agricultural agencies ▪ NGOs: Food rescue and advocacy
Expand Value-added Processing and Packaging Adjustments	Develop technologies to extend the freshness or shelf-life of food, through innovation in value-added processing and packaging.	▪ Cultivate innovation, by expediting regulatory approval processes for food products processed or packaged with new technologies, while also considering potential impacts or unintended consequences of a particular idea/innovation. ▪ Increase investment (private, government and foundation) in research projects that support development of technology, identifying and activating markets, and seeking uses for currently wasted products (and byproducts). ▪ Facilitate connections between stakeholders involved in value-added processing and packaging technology (e.g., surplus food generators, technology developers, investors).	▪ ICI: Processors, investors ▪ Government: Food and agriculture agencies ▪ NGOs: Academia, foundations, food rescue

Food Rescue and Recovery

Table 10 outlines opportunities for food rescue and recovery, along with considerations for implementation. The opportunities apply across all stages of the food supply chain unless otherwise noted.

TABLE 10. **Opportunities for Food Rescue and Recovery**

Opportunity	Description	Considerations	Stakeholders Involved
Explore Food Rescue Incentives	Explore various incentive mechanisms for food donations (if not already existing) and opportunities to expand funding to improve infrastructure related to storage, transportation, and donation-tracking in food rescue and recovery systems.	▪ Establish evidence to justify the need for, benefits of and selection of incentive mechanisms to support food rescue and recovery, in each country. ▪ Prioritize infrastructure to improve logistics and appropriate storage of healthy (often more perishable) foods. ▪ Address the dignity and right-to-food aspects of the food-insecure population: food quality, nutritional requirements, and accessibility of food, as pertain to vulnerable populations. ▪ Consider challenges smaller donors may face when attempting to take advantage of tax incentives, given lack of systems to track donations and limited infrastructure to store and transport donations.	▪ ICI: Companies, associations ▪ Government, including municipal, provincial and federal: environmental, agricultural, food and health agencies ▪ NGOs: Food rescue and advocacy

Measuring, Tracking and Reporting Food Loss and Waste

Table 11 outlines opportunities for measuring, tracking and reporting FLW, along with considerations for implementation. The opportunities apply across all stages of the food supply chain unless otherwise noted.

TABLE 11. **Opportunities for Measuring, Tracking and Reporting Food Loss and Waste**

Opportunity	Description	Considerations	Stakeholders Involved
Standardize Measuring, Tracking and Reporting	Use terms, definitions and reporting framework, in each country, that are consistent with the *Food Loss and Waste Accounting and Reporting Standard* (WRI 2016).	▪ Evaluate globally available approaches for measuring, tracking and reporting that may be applicable to North America. ▪ Promote use of the *Food Loss and Waste Accounting and Reporting Standard* (WRI 2016) across the three North American countries, to standardize measurement for monitoring and comparison purposes. ▪ Pool funding and in-kind resources, to develop robust measurement methodologies and provide technical support to stakeholders across the food supply chain so that they may employ comparable methods in measuring, tracking and reporting FLW.	▪ ICI: Companies, associations ▪ Government: Environment, food and agricultural agencies ▪ NGOs: Academia, foundations, food rescue and advocacy
Track and Report Performance	Establish benchmark (baseline) FLW for each country and track changes in FLW over time.	▪ Harmonize measurement methodologies across the three countries, to provide more accuracy and consistency. ▪ Build on existing reporting systems for FLW (e.g., census data and national surveys; taxation; corporate annual reporting; business permits and licensing; tracking of utility usage; tracking by industry associations; audits and tracking of GHG emissions inventory). ▪ Define a base-year for tracking FLW over time. ▪ Ensure consistency in tracking and reporting over time, to produce results that are reliable and comparable. ▪ Report FLW data on a regular basis, as agreed upon by all three countries, to evaluate progress on goals/targets (as applicable). ▪ Conduct full-life-cycle analysis of the supply chain for FLW, including greenhouse gas emissions, and environmental and socio-economic impacts.	▪ ICI: Companies, associations ▪ Government: Environment, food and agricultural agencies ▪ NGOs: Academia, foundations, food rescue and advocacy

Limitations of Analysis

The objective of this study was to provide an analysis of food loss and waste (FLW) in Canada, Mexico and the United States. The assessment delivered in the report:

- characterizes the scale and causes of FLW generation;
- identifies initiatives aimed at reducing, rescuing, recovering and measuring FLW;
- identifies successes and challenges faced by FLW projects, programs and policies (including both regulatory and non-regulatory tools) across North America;
- provides an analysis of the environmental and socio-economic impacts of FLW; and
- identifies opportunities for improving FLW reduction, food rescue, wasted food recovery and measurement.

Due to the emerging nature of FLW analysis in the three countries, this research project encountered several challenges. Table 12 shows the limitations of the analysis presented in this report, and potential options to overcome these limitations.

TABLE 12. **Limitations of Analysis**

Limitation of Analysis	Potential Options to Overcome Limitation
Current lack of primary data on FLW from some businesses, institutional sources, and international catering sources of waste (e.g., airlines, trains, cruise ships, military), which resulted in data gaps	Access additional unpublished data from the ICI and public sector. Include proxy data from other disposal methods (e.g., open dumping, sewage disposal, composting) of FLW, to generate a more comprehensive estimate.
Comparable methodology and scope for FLW measurement not available across North America	Use the framework in *Food Loss and Waste Accounting and Reporting Standard* (WRI 2016) to map out methodologies for comparison. Further define gaps/needs and development guidance, and support improved FLW measurement methodologies.
Country-specific data and quantification method for life-cycle greenhouse gas emissions analyses were not available for all three North American countries	Develop country-specific emission factors and methodology, based on available data and methodologies from other countries.
Country-specific data on environmental and socio-economic impacts were not available for all three North American countries	Build on existing environmental and socio-economic impact quantification models, using proxy data to customize by country.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