

Food Loss Across Transforming Food Systems

July 20th, 2023

Robin Shrestha | Jocelyn Boiteau | Prabhu Pingali



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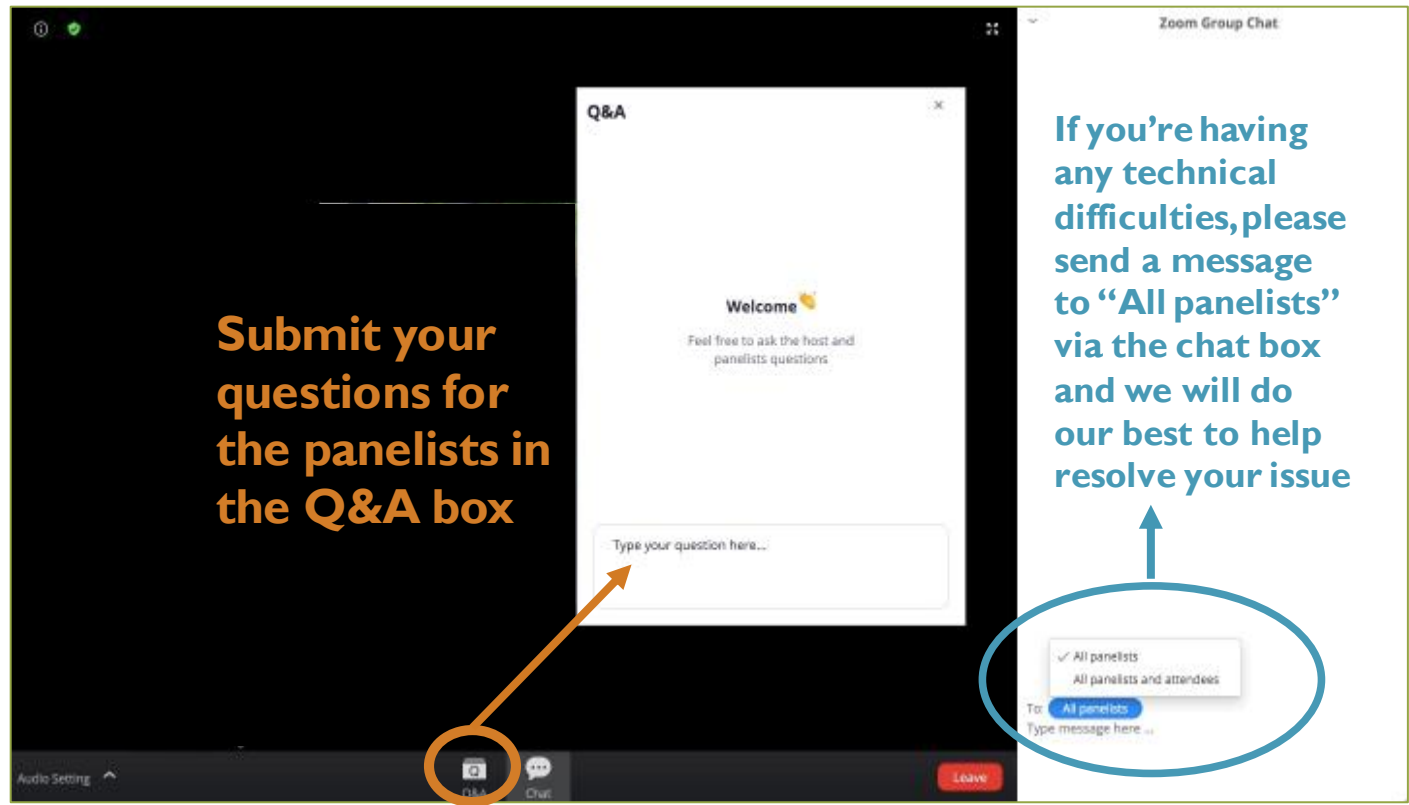
The U.S. Government's Global Hunger & Food Security Initiative

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The U.S. Government's Global Hunger & Food Security Initiative

The Food Systems for Nutrition Innovation Lab Presents:

Food Loss Across Transforming Food Systems

Zoom Webinar | Thursday, July 20th, 2023 | 1:00-2:00 PM (ET)



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Food loss across transforming food systems

Tata-Cornell Institute for Agriculture and Nutrition

Jocelyn Boiteau and Prabhu Pingali

20 JULY 2023

PREVIOUS WORK ON FOOD LOSS AND WASTE AT TCI

Original Research Communications

Food loss of perishable produce from farm to retail: evidence from tomato supply chains in South India

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ABSTRACT
Background: Reducing food loss and waste (FLW) may narrow gaps between fruit and vegetable production and recommended intake. However, FLW estimates are inconsistent due to varying estimation methods.
Objectives: Using multiple estimation approaches, we examined the extent and determinants of FLW along tomato supply chains in South India, from farm to retail. We also explored tomato quality assessments.
Methods: We surveyed 75 farm households and 83 tomato traders in the Chittoor district, Andhra Pradesh, and 52 vegetable traders and 50 vegetable retailers in Hyderabad, Telangana, on harvest and market days. We calculated declared FLW values using participant-reported losses to estimate the preharvest quality FLW and quantitative FLW values at the farmer, vegetable-trader, and vegetable-retailer stages. We calculated the destination FLW based on counted crates diverted to loss destinations, using participant-reported destinations (animal feed, field discard), to estimate the postharvest FLW from farm to retail. We used pile sorting with farmers to explore on-farm quality assessments.
Results: The average preharvest quality FLW was 13.9% of harvested tomatoes. From farm to retail, the quantitative FLW was greatest at the postharvest, farm level. Among all harvests, the median postharvest, farm-level FLW was 0.0% (IQR, 0.0%–7.9%) using the destination FLW approach (tomatoes diverted to nonfood uses) and 2.3% (IQR, 0.0%–12.5%) using the declared FLW approach ($P < 0.05$). Among harvests with a non-zero postharvest, farm-level FLW, the median FLW was 9.1% (IQR, 2.4%–16.7%) using the destination FLW approach (tomatoes diverted to nonfood uses) and 10.0% (IQR, 2.9%–16.7%) using the declared FLW approach. Harvesting during peak season was a determinant of postharvest, farm-level and preharvest, market-level FLW values. Farmers prioritize color/ripeness attributes while harvesting and tomato size while grading.
Conclusions: Single-point estimates may obscure FLW patterns for perishable, indeterminate crops and depend on data collection and estimation methods. Reducing FLW of perishables requires the integration of quantitative and qualitative FLW estimation methods.
Am J Clin Nutr 2022;0:1–14.

Keywords: food loss and waste, food supply chain, loss destination, food quality, perishable vegetables, tomato, India

Introduction
 The current global food system continues to struggle to provide healthy diets in the setting of increasing environmental changes. Shifting towards healthier, environmentally sustainable dietary patterns will require, in part, increased consumption of healthy foods, including fruits and vegetables, improved food production practices, and food loss and waste (FLW) reductions (1). The United Nations Sustainable Development Goal (SDG) 2, zero hunger, targets agricultural production and nutrition. However, the SDG 2 targets lack coordinated action and overlook value chain actors and activities that connect food production to food consumption (2). In many global regions, there are already deficits in fruit and vegetable availability to meet dietary recommendations, particularly in sub-Saharan Africa and South Asia (3–5).
 Fruits and vegetables are among the more perishable food groups and are more at risk of FLW. As part of SDG 12

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Can we agree on a food loss and waste definition? An assessment of definitional elements for a globally applicable framework

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ARTICLE INFO	ABSTRACT
Keywords: Food loss Food waste Definitions FLW database Harmonization	Recent strategies for achieving sustainable food systems have called for reducing food loss and waste (FLW), most notably Sustainable Development Goal (SDG) target 12.3. This review aims to compare FLW definitions that are relevant to SDG target 12.3 and opportunities to harmonize the FLW definition. Using the FAO FLW database, we summarize FLW data source availability and distribution across country income groups. Across 21,786 data points from 2004 to 2021, over one-third (64.5%) are sourced from the African Postharvest Loss Information System, which focuses on cereal grains in sub-Saharan Africa. We then compare FLW definitions from major data sources to a common FLW definition put forth by FAO in 2014, and the Food Loss Index and Food Waste Index sub-indicators for SDG target 12.3. We find that the indices do not align with other definitions with regard to utilization and edibility criteria. After assessing each definitional element, we conclude that the FAO 2014 FLW definitional framework is comprehensive and globally applicable; summarized as, a reduction in the quantity or quality of the edible portion of food intended for human consumption when food is redirected to non-food uses or when there is a decrease in the nutritional value, food safety, or other quality aspect from the time food is ready for harvest or slaughter to consumption.

1. Introduction
 Reducing food loss and waste (FLW) has emerged as an important strategy for achieving sustainable food systems. The most notable call for FLW reduction comes from Sustainable Development Goal 12 (SDG 12), target 12.3, which aims to reduce global food waste at the retail and consumer levels by half and to reduce food losses along production and supply chains by 2030. In 2014, the High Level Panel of Experts on Food Security and Nutrition recommended that stakeholders agree on a definition for FLW to improve data collection and knowledge sharing (HLPN, 2014). However, there is still no single agreed-upon FLW definition. Food loss and waste estimations rely on defining what is meant by FLW (i.e., a definitional framework) and how FLW is measured (i.e., a measurement framework). There continue to be many, varied definitions and approaches to conceptualize FLW, resulting in an abundance of terms that make it difficult to identify exactly what is being discussed, measured, and addressed (Delgado et al., 2017; FAO, 2014; Kihioja et al., 2018a). Inconsistencies in definitions can limit the comparability of FLW estimates (Kihioja et al., 2018a), the synthesis of current research questions, and the identification of research gaps (Chaubou et al., 2021). This becomes a particular issue when data are aggregated to determine macro-level FLW estimates.
 Prior to SDG target 12.3, an estimated one-third of all food produced for human consumption was lost or wasted, globally (FAO, 2011). The most recently updated global FLW estimates indicate that 13.8% of food is lost after harvest up to, but not including, retail, and 17% of total food production may be wasted between retail, food service and household stages (FAO, 2019; UNEP, 2021). While similar terminology is used across these estimates (i.e., “food loss and waste”, “food loss”, “food waste”), the underlying definitions of what counts as FLW are different, rendering the estimates incomparable. One such difference, the SDG target 12.3 indicators do not consider food diverted to animal feed as FLW whereas the definition used in FAO 2011 considered food diverted to animal feed as FLW (FAO, 2019, 2011).
 Previous work has highlighted inconsistencies in how FLW is defined and analyzed. Using a comparison of FAO and European Commission FLW definitions, Chaubou and Daviron (2017) identify inconsistencies between each entity’s perspective on the FLW issues and the definition developed. The authors further elaborate on inconsistencies between the identified issues and the quantification methodologies as well as the data available and used (Chaubou and Daviron, 2017). Spang et al.

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 2211-9124/© 2023 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

MOTIVATION AND APPROACH

- Motivations for food loss and waste (FLW) reduction focus on **environmental, socioeconomic, and food security** improvements
- FLW reduction depends on understanding the nature of the problem within a given context, accounting for **structural transformation of economies and food systems transformations**
- Approach to broadly synthesize FLW evidence
 - Use a **food systems lens** to examine FLW across the range of actors and activities
 - Focus on LMICs to explore **entry points for FLW investment and intervention** priorities
 - Apply a **globally applicable FLW definition** to consistently conceptualize and examine FLW

BOOK OVERVIEW

Part I: Definition and methodological frameworks

- Defining FLW and food quality
- Measurement approaches for physical FLW and food quality loss

Part II: Pathways linked to food security

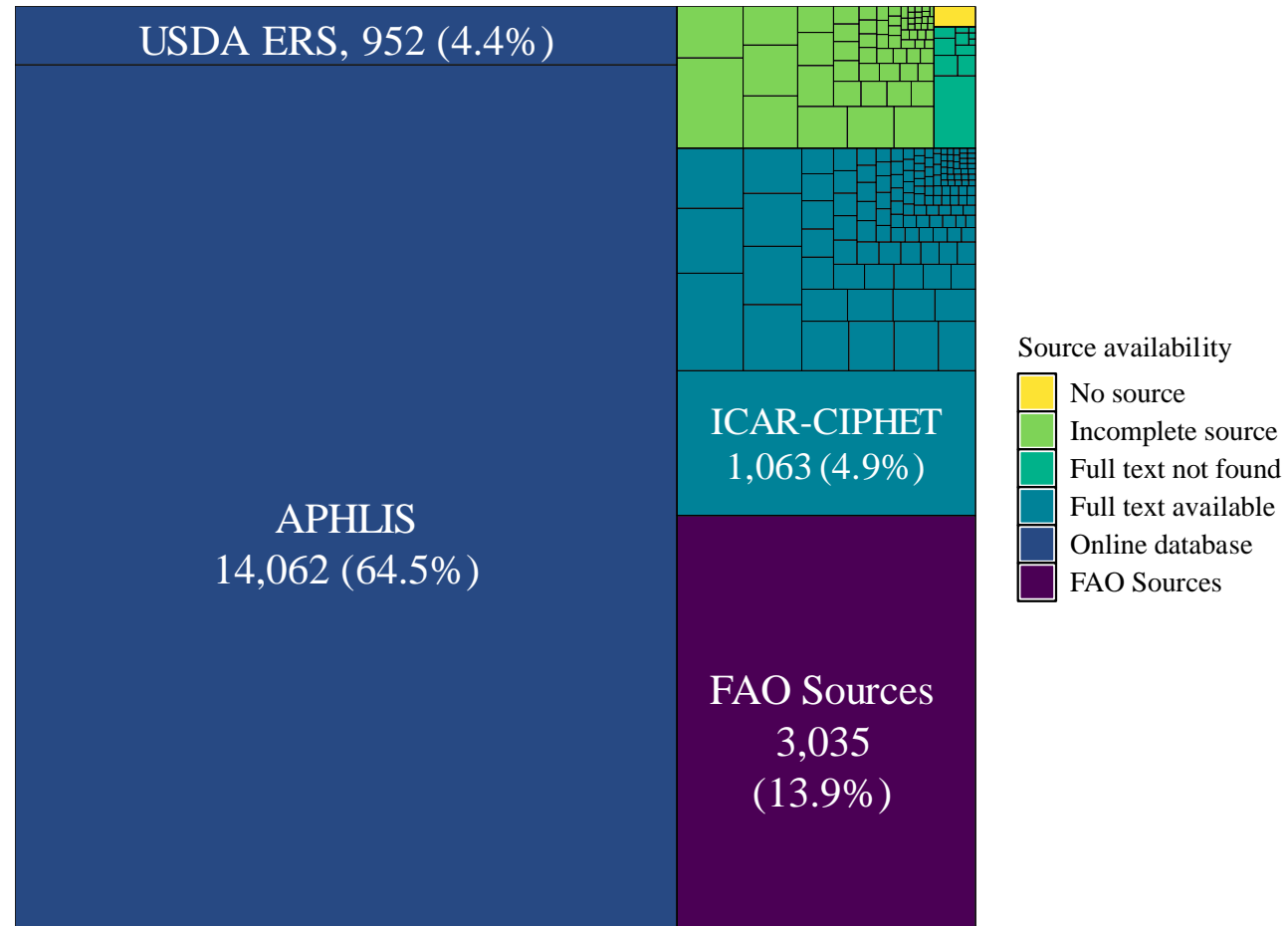
- FLW linked to safe and nutritious foods
- FLW linked to availability
- FLW linked to accessibility and affordability

Part III: Approaches to prevent and manage FLW

- Navigating investment priorities and leverage points
- Interventions linking technology, governance, and practice
- Opportunities and challenges for inclusion
- Policy agenda for FLW reduction

PART I: DEFINITION AND ESTIMATION FRAMEWORKS

SOURCES OF FLW DATA FROM FAO FLW DATABASE, 2004-2021



Boiteau, JM & Pingali, P. (2023)
doi: 10.1016/j.gfs.2023.100677

COMPARISON OF FLW DEFINITIONAL ELEMENTS

SDG 12.3 Indicators

Definitional element	FAO (2014) ^b	APHLIS ^c	USDA ERS ^d	ICAR-CIPHET ^e	Aligns with FAO 2014	Food Loss Index ^f	Food Waste Index ^g	Aligns with FAO 2014
Timing	Ready for harvest or slaughter ^h	Ready for harvest or slaughter ^h	Postharvest	Start of harvest or slaughter operations	✗	Postharvest	<i>Not specified</i>	✗
Scope	Food supply chain: intended for human consumption ⁱ	Food supply chain: intended for human consumption ⁱ	Food supply chain: intended for human consumption ⁱ	Food supply chain: intended for human consumption ⁱ	✓	Food supply chain: human-edible commodity	Food supply chain: intended for human consumption ⁱ	✗
Terminology	Terms	Food loss and waste ^j	Postharvest loss	Food loss; Food waste	✗	Food loss	Food waste	✗
	Stages	Farm to consumer	Farm to consumer	Farm to consumer ^k	✓	Farm up to, but not including, retail	Retail, food service (i.e., out-of-home consumption), household	✗
Criterion	Utilization	Non-food uses	Non-food uses	Non-food uses	✓	Non-food, non-economically productive uses ^l	Non-food, non-economically productive uses ^m	✗
	Edibility	Edible portion	<i>Not specified</i>	Edible portion	✓	Edible and inedible portion	Edible and inedible portion	✗
Type	Quantitative and Qualitative	Quantitative and Qualitative	Quantitative	Quantitative and Qualitative	✗	Quantitative	Quantitative	✗

Chaboud & Daviron (2017) doi: 10.1016/j.gfs.2016.11.004

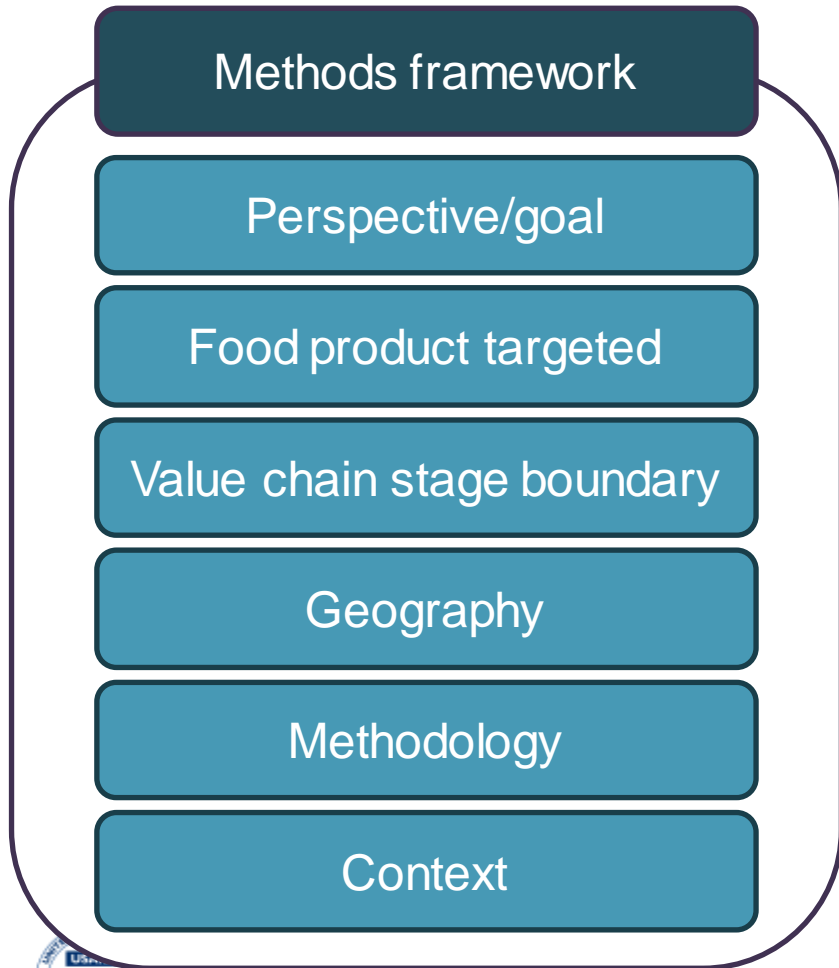
Boiteau, JM & Pingali, P. (2023) doi: 10.1016/j.gfs.2023.100677

DEFINITIONAL FRAMEWORK APPROACH

Food loss and waste is a reduction in the quantity or quality of the edible portion of food intended for human consumption when food is redirected to non-food uses or when there is a decrease in the nutritional value, food safety, or other quality aspect from the time food is ready for harvest or slaughter to consumption. (adapted from FAO 2014)



SUMMARY OF METHODOLOGICAL APPROACHES



- Most FLW data estimate pFLW, but unreliably due to **lack of standardized methods and reliance on indirect measurement and secondary data** (Fabi et al., 2021; Xue et al., 2017; Kitinoja et al., 2018)
- Food security, environmental sustainability and resource efficiency, and economic perspectives (FAO 2019)
- Significant data gaps by food product, value chain stage, and geography (Spang et al. 2019)
- Review pFLW estimation approaches, summarizing strengths and limitations of **different methods within operational contexts**

Physical FLW

- Primary data (direct weighing, counting, volume, surveys)
- Secondary data
- Reporting

Food Quality Loss

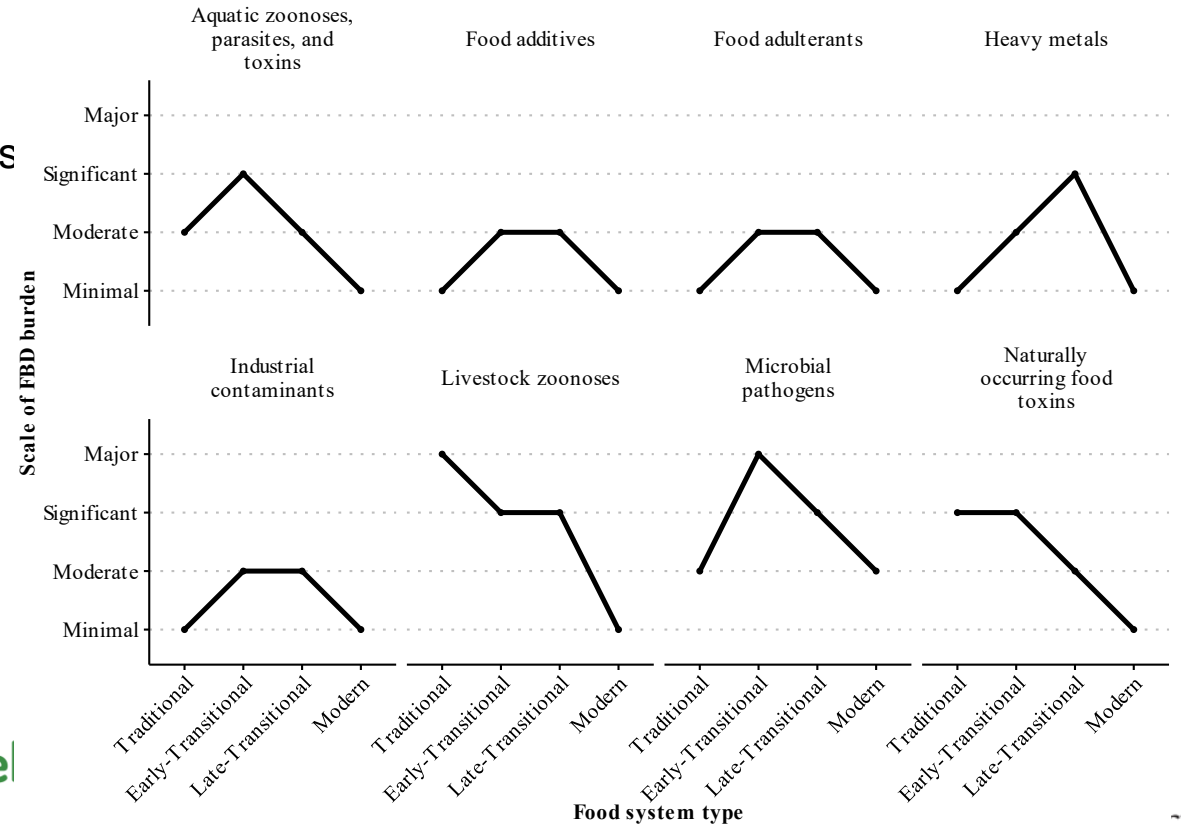
- Composite indicators (grades and categories, price, date labels)
- Individual quality attributes

PART II: PATHWAYS LINKED TO FOOD SECURITY

FLW LINKED TO SAFE AND NUTRITIOUS FOODS



- Food safety loss pathways involve **biological, chemical, and physical hazards**
 - Foodborne hazard sources within food system contexts
 - Correlations with FQL of search attributes (e.g., aflatoxin and damaged grain)
- Nutrient loss pathways involve **nutrient degradation and leaching**
 - Storage timing and environment
 - Extent and type of processing
 - Type of packaging
- Potential food safety and nutrient loss trade-offs



FLW LINKED TO FOOD AVAILABILITY

- FLW pathways at the **pre-harvest and harvest stages** that determine what food enters value chains
- Factors that contribute to **quality attributes of foods destined for fresh and processed** markets
 - Natural development of perishable foods and sources of FQL (i.e., physiological processes)
 - Changes in food quality attributes when fresh foods are processed
 - Sources of FQL (e.g., mechanical, chemical, and environmental)
 - Risks of FLW post-harvest that become barriers to production
- Harvest timing related to **desirable quality attributes** for fresh and/or processed value chains
 - Availability and accessibility of technologies, knowledge, and infrastructure
 - Food quality assessment and acceptable quality tolerance limits
 - Capacity to manage issues of seasonality, particularly among perishable products

FLW LINKED TO ACCESSIBILITY AND AFFORDABILITY

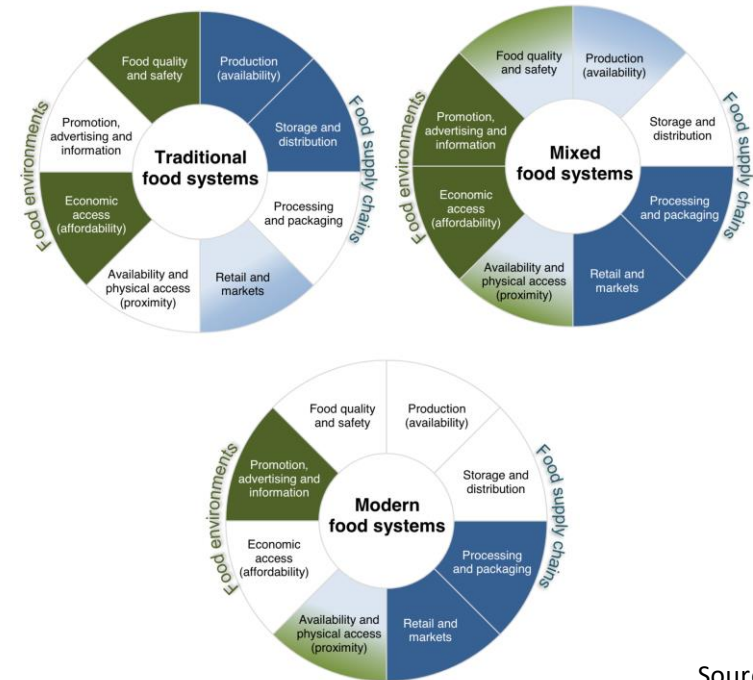
- **FLW pathways at postharvest stages** that determine what foods move along the value chain and reach consumers
 - Food quality loss and pFLW throughout transportation, storage, processing, distribution stages
 - Physical FLW at storage and processing stages contributes to FQL of final product
 - Potential for FLW reduction to contribute to structural transformation
- **Food quality loss and/or changes in acceptable quality limits** in food environments lead to pFLW
 - Structure and location of markets that serve different consumers
 - Strategies to avoid pFLW influence types of food commodities accessible in certain markets
- Role of trade in determining **quality standards, compliance issues, and redirection**
 - Foods that frequently do not meet standards
 - Identify which foods are redirected, where they are redirected, and causes of FQL and/or pFLW

PART III: APPROACHES TO PREVENT AND MANAGE FLW

NAVIGATING INVESTMENT PRIORITIES AND LEVERAGE POINTS

- Summarize evidence on critical points where FLW occurs and along which FLW pathways
 - Food commodity
 - Food system type
 - Value chain actors involved
- Examine the causes of FLW and potential entry points for intervention
 - Location of FLW may be different than cause(s)
 - Integrate discussion of feedback loops and tradeoffs
- Identify alignment of leverage points with investment priorities for each food system type

Prioritized investment across food system types

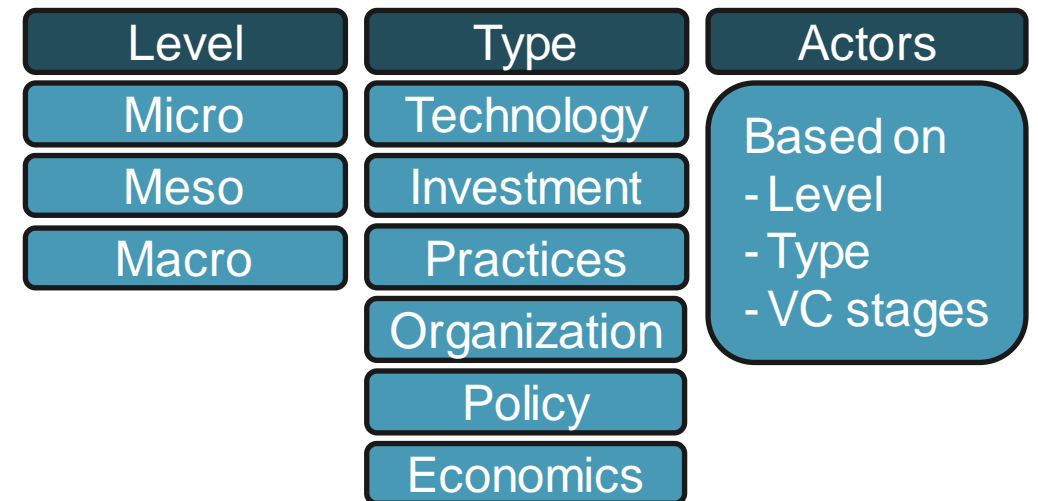


Source: HLPE (2017)

AN INTERVENTION TOOLBOX: LINKING TECHNOLOGY, GOVERNANCE, AND PRACTICE

- Examine evidence on FLW-reducing interventions by level, type, and actors involved
- Consider food system type and defining features
 - Interventions facilitated by higher level actions
 - Types of interventions available and accessible at a given stage of structural transformation
 - Changes in the roles and influence of actors
- Identify facilitators and barriers to implementing different sets of strategies across food system contexts
- Examine areas of synergy across different FLW pathways

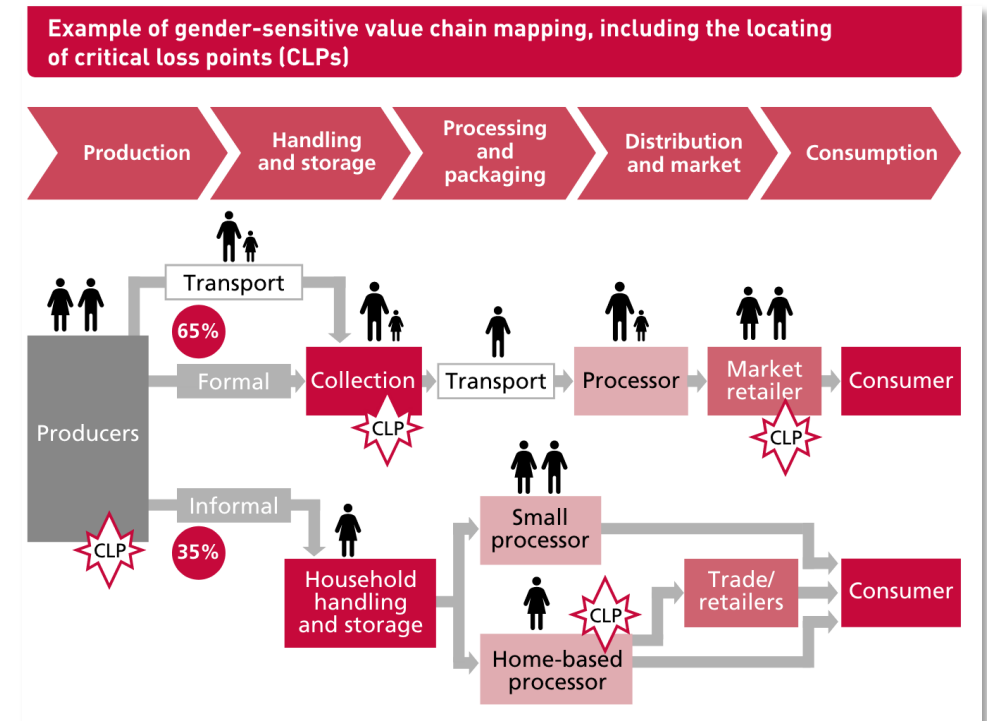
Aspects of FLW-reducing interventions



Source: Soethoudt et al., 2021

OPPORTUNITIES AND CHALLENGES FOR INCLUSION

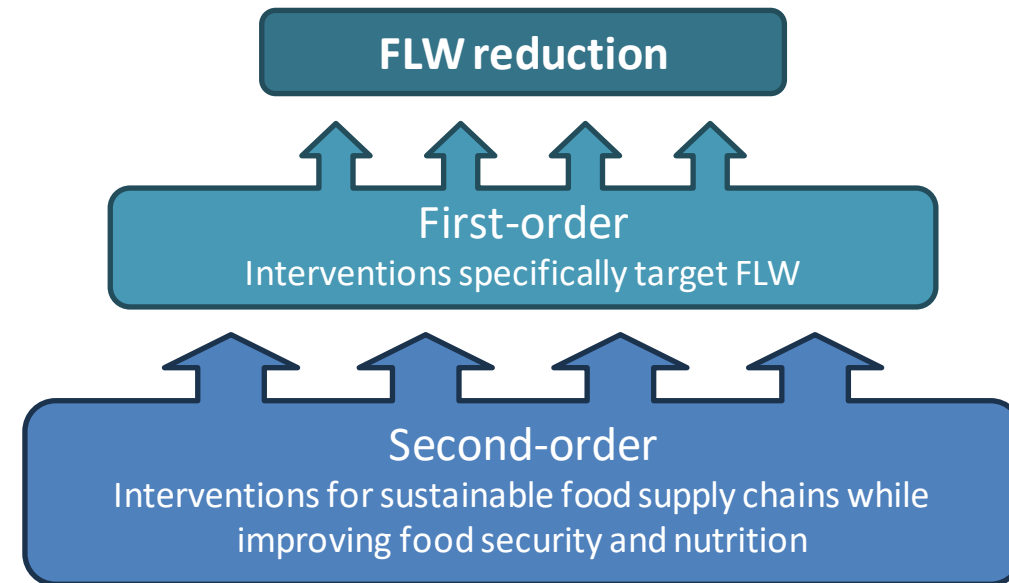
- FLW estimation methods may inadvertently exclude women's participation and contribution
- Consider gender-based constraints that influence division of labor and access to knowledge, services, technologies, and other resources (FAO, 2018)
- Informal markets can be overlooked when it comes to FLW-reduction strategies
- Identify potential gaps related to gender constraints and informal markets in FLW measurement methods and reduction strategies



Source: FAO 2018

POLICY AGENDA AND THE WAY FORWARD

- Two broad approaches to address FLW (Cattaneo et al., 2021)
- First-order policies to specifically target FLW
 - How policies align with investment priorities
 - Challenges to implementation
 - Potential cascading effects along value chains
 - Impacts, if any, on food security
- Second-order policies that prevent or manage FLW
 - Underlying causes of FLW linked to broad policy priorities
 - Gaps in knowledge and policy coherence
 - Unintended consequences to FLW pathways and food security
- Identify promising and inclusive policy agendas that align FLW prevention with food security investment priorities



THANK YOU

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Q&A



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