



Measuring Food Loss for SDG 12.3.1a: Indonesia's Experience

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Abstract

Despite the strategic importance of the SDG 12.3.1a indicator, the Food Loss Index (FLI), for strengthening food security, most countries, including Indonesia, have not yet produced official measurements of this indicator. To address this gap, and with technical support from the Food and Agriculture Organization (FAO), Statistics Indonesia has initiated the development of an FLI using data from the Distribution Channel Survey. Leveraging existing data represents a cost-efficient strategy that maximizes data reuse while minimizing the financial and logistical demands of conducting new large-scale data collection. This paper examines the technical methodologies used to analyze these data for FLI calculation, the associated challenges and strategies for index construction, and potential improvements to the survey design to more comprehensively capture food loss information.

Keywords: food loss; food chain, agricultural survey

1. Introduction

Food Loss and Waste (FLW) has attracted increasing attention over the past decade, particularly in Indonesia, following the implementation of the nutritional free meal program in early 2025 under President Prabowo Subianto's administration. This policy has highlighted the urgency of reducing losses occurring during harvest and post-harvest stages. Effective implementation of such a large-scale programme requires reliable information on food availability, supply chain capacity, and the extent of losses across key commodities. The importance of this issue is also reflected in the Target

of Sustainable Development Goals (SDGs) 12.3.1 to halve per-capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses, by 2030.

Measuring food loss, determining where it occurs within the food system, and formulating effective policies throughout the entire value chain are critical initial steps in tackling food loss and waste in developing countries ⁽¹⁾. An officially produced FLI will support the Government in identifying critical loss points, optimizing procurement and distribution strategies, and enhancing the overall efficiency of food supply chains. In doing so, the FLI will contribute directly to national efforts to reduce loss, strengthen food security, and ensure the sustainable delivery of nutritious meals to beneficiaries. Despite its strategic importance, research on measuring and analyzing FLI remains limited ⁽²⁾, constraining the availability of harmonized and comparable data needed to support evidence-based policymaking. Therefore, establishing an official FLI represents an important step toward closing this data gap and strengthening monitoring of national food system performance.

To effectively manage this issue, Indonesia needs high-quality data to support evidence-based policy. This led to a collaborative work between BPS, FAO, and the Government to harmonise existing Indonesian data with global statistical methodologies developed by FAO and approved by the UN Statistics Commission, which represents over 180 countries. FAO provides technical assistance to countries in producing SDG indicators, including indicator 12.3.1.a, in collaboration with FAO focal points from designated divisions. Where possible, we maximize data reuse by using existing data to reduce the costs and burden of new large-scale data collection exercises. Besides, by following international methodologies, we ensure sound statistics and the ability to compare food loss across time and across countries.

This study compiled and analysed data from the National Distribution Channel Survey (POLDIS) and reported on food losses, applying the global methodology for SDG Indicator 12.3.1a within the Indonesian statistical context. The paper is divided as follows. The first section presents the national and global context of food loss measurement. We then outline the methodology for the Food Loss Index, in line with international standards. In the third section, we describe the POLDIS and data collection framework, followed by our key findings for Indonesia and a discussion of the current survey to capture food loss. The paper concludes with recommendations to improve the FLI measurements.

2. Methodology and Data Source

2.1 Definition of Food Loss

Food loss and waste (FLW) refer to the reduction in food quantity or quality along the supply chain. Food loss occurs along the production side of the food supply chain, from harvest through, but excluding retail. In contrast, food waste is the decrease in the quantity or quality of food resulting from decisions and actions by retailers, food service providers, and consumers ⁽³⁾.

FLW levels, estimated at around 30 percent of global food production ⁽⁴⁾, reflect inefficiencies that generate significant economic, social, and environmental impacts across global, regional, national, and local agrifood systems. FLW negatively impacts food security and nutrition; contributes significantly to greenhouse gas emissions, environmental pollution, and the degradation of natural ecosystems and biodiversity; and represents a waste of resources, including inputs, energy, water, and land used in food production. Globally, FLW accounts for nearly a quarter of all water used in agriculture and is responsible for an estimated 8 to 10 percent of annual greenhouse gas emissions.

FLW occurs across the value chain, with Figure 1 below showing the boundaries between food loss and waste and pre-harvest losses, which are defined as damage.

Progress towards target 12.3 is monitored by two indicators: 12.3.1a, the Food Loss index, for which the FAO is the custodian agency; and 12.3.1b, the Food Waste Index, for which the UN Environment Programme (UNEP) is the custodian agency. Custodian agencies are tasked with developing and piloting the global methodology and presenting it for endorsement by UN member states through the UN Statistics Commission; developing and publishing advocacy and training materials; providing technical assistance to build the capacity of countries in collecting data and compiling and publishing the indicator; validating the indicators reported by countries before global reporting; and ensuring their use in SDG progress reports at national, regional and global levels.



Source: ⁽⁵⁾. *The State of Food and Agriculture 2019: Moving forward on food loss and waste reduction*. Rome, FAO. <https://www.fao.org/3/ca6030en/ca6030en.pdf>

Figure 1. Boundaries of food loss and food waste for SDG 12.3.1

2.2 Methodology of FLI Calculation

The FLI methodology follows the global standard developed by the FAO. The FLI compares Food Loss Percentages over time and measures their relative change over a set period. The FLI can be computed through four distinct and sequential mathematical calculations. Here are the steps:

Step 1: Select the commodities basket

The global methodology for SDG 12.3.1a recommends that the FLI cover at least 5 commodity groups, with 2 products from each. The five groups include: 1) Cereals and Pulses; 2) Fruits and Vegetables; 3) Roots, Tubers and Oil-Bearing Crops; 4) Animal Products (meat, milk, eggs); and 5) Fish and Fish Products. Countries may use a sixth category specific to their country, in addition to or as a replacement for one of the five main categories. The sixth optional category may be created, for example, to cover cash crops such as stimulants, spices, sugars, and nuts.

Countries may apply the following criteria in selecting commodities, including economic and social criteria. Economic criteria include the commodity's share of the value of agricultural production, value of domestic consumption, and/or value of exports. Social criteria may include impacts on healthy diets, food security, and related areas. Since the index itself weights commodity loss by the commodity's share of the value of production, it is important that, regardless of the

criteria, the commodity selected should not reflect a low contribution to the total agricultural value of production.

Step 2: Compiling weight

To weigh the different commodities in the FLI, it is essential to select a set of weights that reflects the multiple objectives of the food loss reduction strategy. Losses are weighted by the value of production of each commodity, representing their relative economic importance. The value of production may be expressed in any currency. However, to avoid comparability issues arising from the use of different currencies and variations in national price levels, the default weights are based on the value of commodities expressed in international (US dollar) prices in the reference year. Countries may use domestic prices for national-level monitoring of the Food Loss Index and Food Loss Percentage.

Step 3: Compile food loss percentages

The Food Loss Percentage (FLP) is calculated as the average loss across multiple commodities. However, commodities do not necessarily have equal importance or weights in the overall calculation. The FLP encompasses losses occurring at different stages of the food supply chain and therefore cannot be measured as a single, aggregated loss at a single point in time (Figure 1).

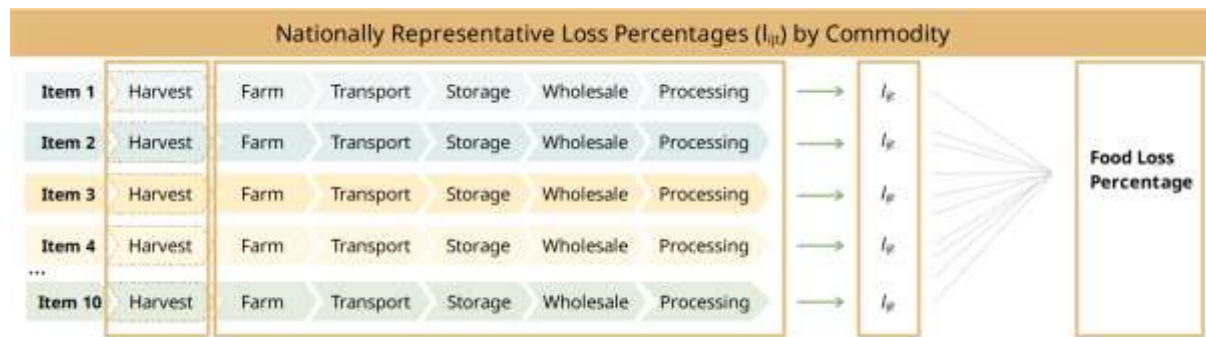


Figure 1. Nationally Representatives Loss by Commodity

The FLP is the average loss rate of the commodities that are vital to a country's food system, including crops, animal products, and fisheries. This figure is the weighted average of all commodities' loss percentages, with weights equal to each commodity's value of production. The FLP for a country i in a year t is defined as follows:

$$FLP_{it} = \frac{\sum_j l_{jt} * (q_{jt0} * p_{jt0})}{\sum_j (q_{jt0} * p_{jt0})} \quad (1)$$

Where:

l_{jt} is the loss percentage for commodity (j) and year (t)

q_{jt0} is the production quantity by commodity in the base period

p_{jt0} is the commodity price for the base period

Although the global methodology used 2015 as base year (averaged from 2014 to 2016), in this study, we used 2019 (the average of 2018 to 2020), as the base period by consideration that BPS changed the methodology for collecting data on paddy and corn harvested area after 2018, from the eye-estimated method to a more reliable survey, namely the Area Sampling Frame Survey.

Step 4: Computing Food Loss Index

The Food Loss Index compares the current Food Loss Percentage to its value in a base period. The Food Loss Index can be computed using the following formula⁽³⁾:

$$FLI_t = \frac{FLP_t}{FLP_0} * 100 \quad (2)$$

In which the Food Loss Index in the year t (FLI_t) is equal to the Food Loss Percentage in the year t (FLP_t) divided by the Food Loss Percentage in the base year (FLP_0) multiplied by one hundred.

2.3 Data Source

Data used to calculate the food loss index comes from the national distribution channel survey (POLDIS) from 2019 to 2024. This annual survey is mainly to collect information on trade distribution patterns of strategic commodities, analyse the primary trade distribution channels and their characteristics, and estimate the total trade and transportation margins (MPP) from producers to end consumers. However, based on our deeper exploration of this survey data, we found that POLDIS also collects the information of trade balance of each business actor and commodity, which covers initial stock, purchase volume, sales volume, damaged and lost volumes, and the effects of market operations, natural disasters, and imports, that we can use to calculate the FLP.

The selection of commodities in this survey focuses on strategic commodities, which meet the following criteria:

1. Highly consumed by the public
2. Has a high Impact on national inflation
3. Food commodities are key contributors to Gross Domestic Product (GDP) growth
4. Critical for public needs. It is usually based on the recommendations from related Ministries/Institutions.

The units of analysis in this survey consist of both trading and non-trading companies or businesses involved in the movement of agricultural commodities. Trading companies span a broad spectrum of business sizes, from medium- to large-sized enterprises to micro- and small-sized businesses. These entities play distinct roles in the distribution system, including distributors, sub-distributors, agents, wholesalers, collectors, exporters, importers, and retailers. In contrast, non-trading companies comprise agricultural production companies and processing industries that contribute to upstream and midstream stages of the supply chain. All surveyed businesses are classified according to the Indonesian Standard Classification of Business Fields (KBLI), ensuring consistent categorization of business activities and enabling comparability with national statistical frameworks. This comprehensive business coverage allows the survey to capture a full picture of supply chain dynamics, providing a solid foundation for analysing food loss across various types of actors.

3. Data Analysis

3.1 Distribution pattern of each commodity

Identifying the distribution pattern for each commodity is a crucial step in calculating the Food Loss Index (FLI), as it provides a clear understanding of how products move through the supply chain from harvest to retail. Each commodity follows a distinct flow, whether through collectors, traders, processors, wholesalers, or directly to markets, and these pathways shape where and how losses occur. Without accurately mapping these distribution patterns, it becomes difficult to determine the appropriate loss percentages, identify the dominant marketing channels, or estimate the relative importance of each node in the supply chain. A well-defined distribution pattern ensures that the FLI reflects the actual structure of commodity movement in Indonesia, thereby improving the accuracy, comparability, and policy relevance of the results.

Table 1 Distribution Channel of Each Commodities

Main commodity	Commodity basket	Distribution Channel	Coverage
Rice (all)	Cereals and Pulses	Importer (+rice milling) → Distributor→Sub-distributor→Agent→Wholesaler	Off farm
Corn (Maize)	Cereals and Pulses	Farmer→ Collector traders→Distributor→Agent→Wholesaler	On farm+ Off farm
Soybean	Cereals and Pulses	Farmer→Collector traders→Distributor→Wholesaler	Off farm
Mackerel	Fish and Fish Products	Fishery→Distributor→Collector traders→Wholesaler→Agent	On farm+ Off farm
Shallot	Fruits and Vegetables	Farmer → Collector trader→Distributor→Subdistributor	On farm+ Off farm
Red Chilli	Fruits and Vegetables	Farmer → Collector trader→Distributor→Wholesaler	On farm+ Off farm
Orange	Fruits and Vegetables	Farmer → Collector traders→Distributor→Subdistributor→Wholesaler	On farm+ Off farm
Chicken	Meat and Animal Products	Slaughterhouse→Distributor→Agent→Wholesaler	Off farm
Beef	Meat and Animal Products	Slaughterhouse→ Wholesaler	Off farm
Egg	Meat and Animal Products	Poultry farmer →Collector trader→Distributor→Agent→Wholesaler	On-farm+ Off-farm

3.2 Commodity loss data by year

Table 2 presents commodity loss along the distribution channel for selected food commodities in Indonesia from 2019 to 2024, categorized into four commodity baskets: cereals and pulses, fish and fish products, fruits and vegetables, and meat and animal products. Overall, food loss varied across commodities, with perishable horticultural products showing consistently higher levels than those of staple crops and animal-based commodities. Food loss for rice within the cereals and pulses category showed a downward trend (from 2.4% in 2019 to 1.4% in 2024), except for a spike in 2020. The loss proportions for corn and soybeans are only available for 2024, so we use the same data for the remaining years, at about 1.3% and 1.0%, respectively. For the fish and fish products group, we have only one commodity: mackerel, with a loss rate of around 0.8%.

On the other hand, fruits and vegetables sustained much more significant losses. Higher loss percentages, above 5% during the entire period, were observed for red chili and orange. Shallot had more volatility, peaking at 4.9% in 2020 before dropping to 2.4% in 2024. These variations indicate that perishable commodities are more susceptible to inefficiencies in post-harvest handling and

distribution. In meat and animal products, however, chicken showed a gradual increase in food loss, ranging from 1.8% in 2019 to 3.0% in 2024. Eggs and beef loss rates are only available for 2019, so we also use 2019 data for the remaining years: 0.3% for beef and 3.1% for eggs.

Table 2. Food Loss Percentage along the Distribution Channel

Main commodity	Commodity basket	Food Loss Percentage (%)			
		2024	2022	2020	2019
Rice	Cereals and Pulses	1.4	0.7	1.9	2.4
Corn	Cereals and Pulses	1.3	1.3*	1.3*	1.3*
Soya Bean	Cereals and Pulses	1.0	1.0*	1.0*	1.0*
Mackerel	Fish and Fish Products	0.8	0.8*	0.8*	0.8*
Shallot	Fruits and Vegetables	2.4*	2.4	4.9	2.1
Red Chilli	Fruits and Vegetables	5.9*	5.9	5.4	4.1
Orange	Fruits and Vegetables	5.4	5.4*	5.4*	5.4*
Chicken	Meat and Animal Products	3.0*	3.0	2.0	1.8
Beef	Meat and Animal Products	0.3*	0.3*	0.3*	0.3
Egg	Meat and Animal Products	3.1*	3.1*	3.1*	3.1

Note: *) Data is not available, and use data from the closest year

3.2 Compiling National Food Loss Percentage

After we calculate the loss for each commodity, we weigh each loss by its production value. In this study, we used the domestic prices. The line chart illustrates the percentage of food loss in the main channel over 2019, 2020, 2022, and 2024. Overall, the food loss percentage declined, then recovered at the end of the period.

The loss of food in 2019 amounted to around 2.1%, the highest level observed over the years. The proportion fell slightly in 2020, to just below 1.9%, marking the first sign of improvement in distribution efficiency. By 2022, however, the point at which food loss fell to about 1.5 percent, the lowest it had been during the period, a more pronounced decrease was underway. The downward trend did not, however, persist. Food loss edged up to about 1.6% in 2024, indicating a partial reversal of previous improvements, but it remained below its 2019 and 2020 levels.

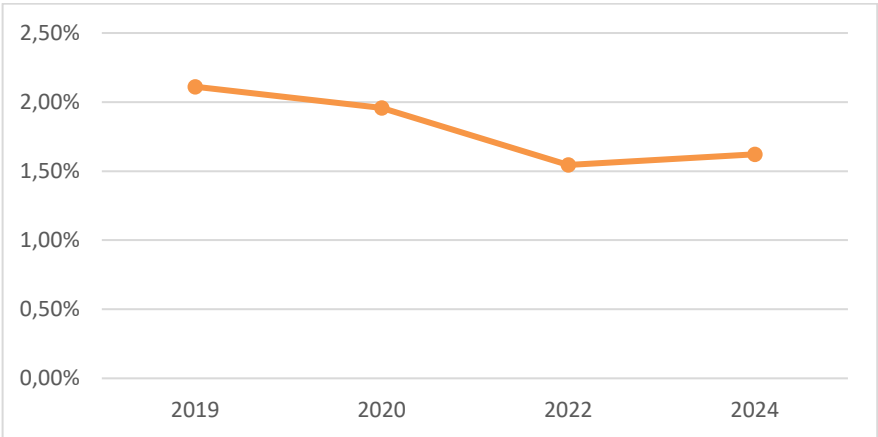


Figure 1. Trend of Food Loss Percentage in Indonesia, 2019-2024

3.3 Compiling Food Loss Index

The final step is to compile the food loss index by comparing the FLP in the current period with the FLP in the base period (2019), then multiplying the difference by 100. The FLI shows a declining trend over the observed period, indicating an overall improvement in the efficiency of the food distribution system (Figure 2). The index decreased from a baseline value of 100.0 in 2019 to 92.7 in 2020, reflecting an initial reduction in food losses across supply chains.

A more pronounced decline occurred between 2020 and 2022, when the index fell to 73.2, representing the lowest level recorded during the period. This substantial reduction suggests notable progress in loss mitigation measures, improved post-harvest handling practices, or enhanced distribution efficiency. In 2024, the Food Loss Index slightly increased to 76.8, indicating a modest reversal of earlier gains. Nevertheless, the index remained significantly below the 2019 baseline, suggesting that overall food loss levels remained lower than at the beginning of the monitoring period. Overall, the trend demonstrates meaningful progress in reducing food losses over time. However, the recent uptick highlights the need for sustained interventions to maintain and consolidate improvements across food supply chains.

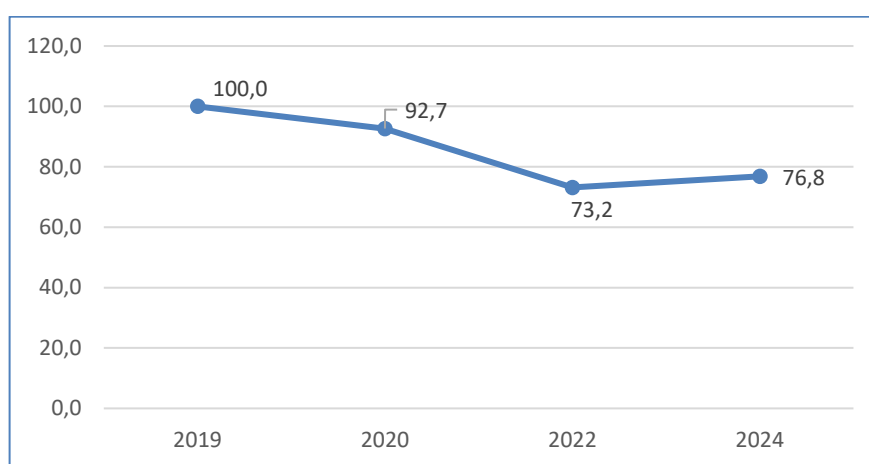


Figure 2. Trend of Food Loss Index in Indonesia, 2019-2024

4. Discussion

4.1 Integration of food loss data collection

The Distribution Channel Survey (POLDIS) is a strategic opportunity to enhance the measurement and monitoring of food loss by integrating food loss data collection into existing statistical operations. We recommend building on a single mechanism (POLDIS) rather than developing a separate survey by including food loss modules on existing POLDIS efforts, thus allowing nationals to generate ‘apples to apples’ comparisons in a cost-effective manner for the globally consistent food loss indicators.

Integrating food loss data collection into POLDIS would document the pathways through which commodities are distributed and the percentage of those products lost at each diversion point along the distribution channel. Considering that POLDIS already records marketing actors, transaction flows, and distribution structures (nodes), integrating precise questions on quantity losses, quality deterioration, and handling practices would yield a complete data set that links supply chain dynamics to loss outcomes. This consolidation would greatly improve the analysis necessary to identify critical choke points across commodity-specific distribution channels.

An approach like this would also improve statistical efficiency by reducing respondent burden and data collection duplication. Using existing infrastructure for surveys greatly helps achieve consistent methodology, reduce operational costs, and incorporate food loss measurement into institutions as sustainable practices.

Running POLDIS periodically with food loss variables incorporated helps monitor FLI over time. Systematic, regular data collection would facilitate longitudinal analysis of trends, enabling policymakers to evaluate the effectiveness of interventions, identify new vulnerabilities in these supply chains as they develop, and appraise how climate variability, infrastructure development, and market changes affect the dynamics of food loss.

Ultimately, integrating food loss measurement into POLDIS will provide a robust statistical system for evidence-based policymaking in support of national food security strategies and facilitate alignment with international monitoring architectures to advance progress on key agricultural indicators (SDG 12.3). The survey would provide a strong empirical basis for targeted policy approaches to reduce food loss by linking distribution channel characteristics to measurable loss indicators, thereby strengthening the potential to improve supply chain efficiency and resilience across food systems.

4.2 Key Challenges Identified

Despite the advantages, using current POLDIS data also poses some challenges, as the survey was not initially designed or intended to calculate food loss. Some of the issues are:

1) Inconsistent Availability of Commodity Data

Survey rounds do not always collect commodity information for all SDG 12.3 commodity basket contents. Missing data for certain commodities in some years hampers comparability over time and limits the ability to build continuous time-series indicators to monitor food loss trends.

2) Limited granularity of loss data

The current questionnaire does not capture food loss at all critical stages of the supply chain for each type of distribution actor. The design of the questionnaire does not fully reflect food loss across all relevant stages in the supply chain; it limits the ability to distinguish between loss mechanisms, as actors differ in how they distribute food and, therefore, in the factors/depth of reasons behind losses. Consequently, current estimates may not accurately capture heterogeneity across critical post-harvest processes, including storage, transportation, market handling, processing, and subsequent retail practices.

Given that analytical capabilities are limited and based solely on this data, organisations are unable to identify not only loss hotspots accurately but also actor-specific vulnerabilities in the distribution chain of commodities. Lack of detailed information on the components and causes of food loss makes it difficult to introduce targeted interventions, prioritize policy initiatives, or evaluate the success of supply chain-engineered solutions in reducing food loss.

3) Absence of On-farm Harvest Loss Data

Food loss is measured at most post-farm stages for some commodities. Examples include rice losses that are currently mostly measured at the rice-milling level; losses incurred during harvesting and immediate post-harvest handling at the farm level are poorly accounted for. However, the lack of on-farm data results in an incomplete estimate of overall food loss along the value chain and underscores the need for complementary surveys focused on primary production stages.

5. Conclusions and Recommendations

5.1 Conclusions

- 1) Institutionalizing food loss measurement within existing survey infrastructure would support long-term sustainability of data production. Statistical efficiency would increase through reduced respondent burden, minimized survey duplication, lower operational costs, and improved methodological consistency.
- 2) Integration of food loss modules into POLDIS would allow systematic documentation of commodity distribution pathways and measurement of loss percentages at each diversion point along the supply chain.
- 3) Regular data collection would help policymakers assess intervention effectiveness, detect emerging supply chain vulnerabilities, and understand the impacts of climate variability, infrastructure development, and market dynamics on food loss.

5.2 Recommendations

- 1) Making sure high-priority commodities are collected regularly: Establishment of a harmonized core list of priority commodities (in line with the SDG 12.3 framework) to facilitate regular collection across survey rounds. A stable commodity basket will enable robust longitudinal analysis to inform food loss trend monitoring.
- 2) Expanding loss-related survey questions: More detailed modules should be embedded in the questionnaire to capture not only losses by actor but also the causes of loss and losses for each critical activity (storage, transportation, processing, and retail). Such an expansion would achieve greater analytical depth of food loss measurement and focus targeted policy interventions.
- 3) Improve Documentation of Distribution Channels: Mapping commodity pathways requires more systematic data collection on marketing flows among business actors. Improved distribution-channel data would enable more effective aggregation techniques, while more complete datasets would facilitate loss estimation across value chains.
- 4) Conduct Pilot and In-Depth Food Loss Surveys: Focused pilot studies or exhaustive surveys are needed to validate food loss estimates based on POLDIS, elicit detailed benchmarks by commodity, and improve measurement approaches, particularly in fisheries value chains, where post-harvest losses may vary widely.
- 5) Conduct Regular Methodological Reviews: Regular methodological reviews should be undertaken to ensure that national practices align with international standards and emerging best practices, including the guidance on measuring food loss at the global level developed in collaboration with the Food and Agriculture Organization. Ongoing methodological enhancements will help the Food Loss Index remain consistent, comparable, and internationally credible.

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