Circular Economy Indicators related to food

SDG and Environment Statistics Unit, 2025
Early Warning and Assessment Division, UNEP

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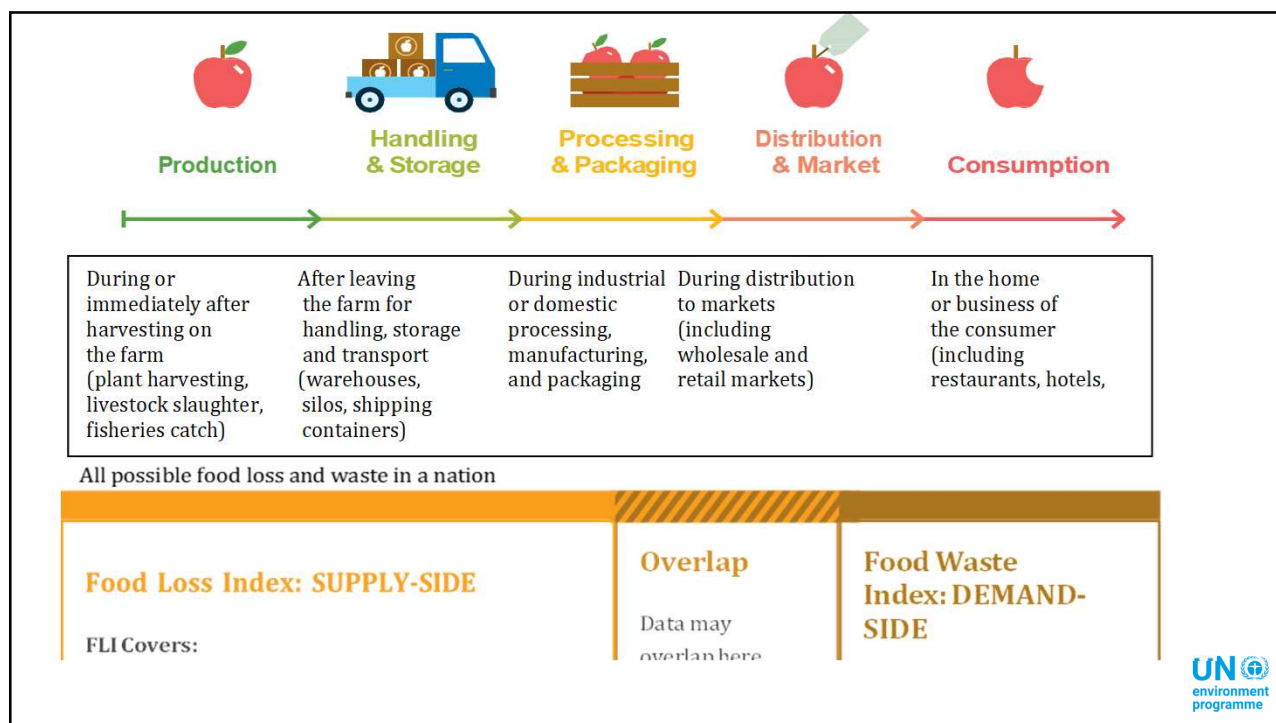# Indicator 4: Food Loss index

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Food loss

This indicator of circular economy corresponds to the SDG 12.3.1 (a) Food loss index.

The methodology for this indicator is based on the UNSD's Metadata for 12.3.1a and the Food Loss+Waste Protocol (2016) Food Loss and Waste Accounting and Reporting Standard.

SDG target 12.3 aims 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.

Indicator 12.3.1 comprises two sub-indicators: 12.3.1a Food loss index and 12.3.1b Food waste index. The two sub-indicators cover discrete food value chain stages, but some overlap is possible at the interface of the manufacturing and retail stages.

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Production	Handling & Storage	Processing & Packaging	Distribution & Market	Consumption
During or immediately after harvesting on the farm (plant harvesting, livestock slaughter, fisheries catch)	After leaving the farm for handling, storage and transport (warehouses, silos, shipping containers)	During industrial or domestic processing, manufacturing, and packaging	During distribution to markets (including wholesale and retail markets)	In the home or business of the consumer (including restaurants, hotels,

All possible food loss and waste in a nation

Food Loss Index: SUPPLY-SIDE

FLI Covers:

Overlap

Data may overlap here

Food Waste Index: DEMAND-SIDE

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Food loss
Additional disaggregation

Countries will likely gain the most value from the disaggregated Food Loss Percentage at the sub-national level by geographic area or agro-ecological zone, points of the value chain (farm, transport, markets, processers), and economic sectors (small-holders or traditional sector versus large and commercial farms/firms).

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Food loss
Interpretation of the indicator (I)

A significant share of food grown for human consumption is never eaten.

This inefficiency has significant economic, social and environmental impacts and is related to food insecurity.

The Food Loss Index monitors progress on the supply side of food chains, and it measures the share of agriculture production that does not reach the retail stage.

The Food Loss Index measures the changes in food loss over time, covering 5 food groups along the supply chain.

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Food loss
Interpretation of the indicator (II)

This indicator complements the indicator Food Waste as both indicators look to divide the food value chain and measure the efficiency of the food system.

The scope of the Food Loss Index starts on the production site with post/harvest/slaughter/catch operations up to but not including the retail level.

Pre-harvest losses are out of scope of the index and harvest losses can be included in the index at the country level only

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Food loss
Interpretation of the indicator (III)

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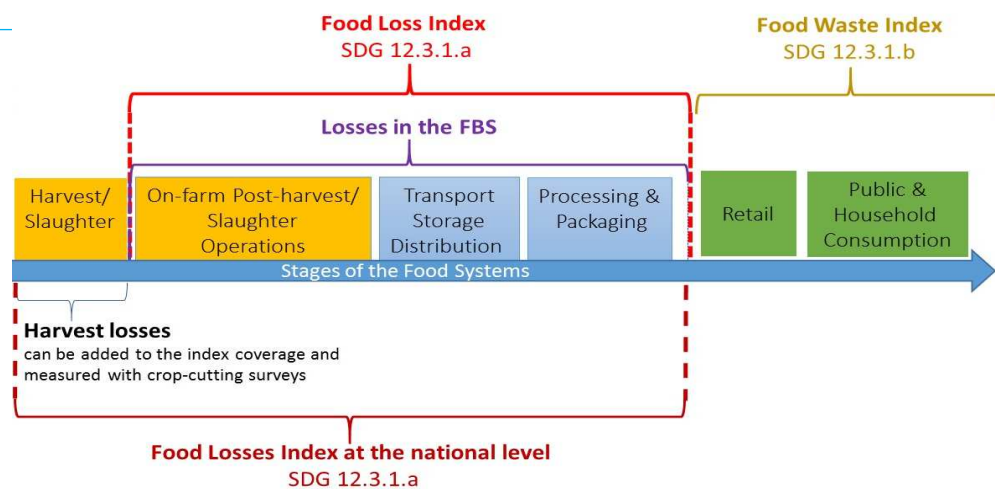
Food loss
Data availability

Food losses data collection occurs through FAO's annual Agriculture Production Questionnaire every year.

At national level, the main data providers are the National Statistical Offices (NSO) and the statistical units of the Ministry of Agriculture/Livestock.

Data sources for agricultural production and on-farm losses are:
- Annual national agricultural surveys, and in the absence of direct measurements, data are interview-based.
- Agricultural census, which FAO recommends conducting every 10 years, may be the only available source of loss estimate.
- Off-farm loss data along the value chain may be obtained through specialized surveys (supplemented by research) through the national agri-food industry system.

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Food loss
Limitations in the use of the indicator (I)

Food losses are an extremely complex phenomenon to measure because they are multi-dimensional and data collection is costly.

The major limitation in its use is due to data unavailability.

This indicator is particularly challenging because it requires data along the whole supply chain. The most appropriate data sources would be an ensemble of surveys, combined with modelling tools and administrative records.

The index scope was reduced for international comparability purposes to exclude harvest losses, which are critical at the production stage.

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Food loss
Limitations in the use of the indicator (II)

Moreover, the index covers only 2 commodities in each food group, because requesting regular loss data for a larger number of products would be a difficult and unsustainable exercise for most countries.

The index monitors only quantitative losses. Qualitative and economic losses that are also very relevant but not measurable in a consistent manner are out of the scope of the indicator.

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Food loss
Calculation of the indicator

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The indicator Food Loss Index (FLI) is a fixed-based index, computed as a ration of Food Loss Percentages in the current year and the Food Loss Percentages in the base year.

$$FLI_{it} = \frac{FLP_{it}}{FLP_{i0}} = \frac{\sum_j l_{ijt} \times q_{ij0} \times p_{j0}}{\sum_j l_{ij0} \times q_{ij0} \times p_{j0}} \times 100$$

FLP_{it} is the average food loss percentage of the country in the current year,
FLP_{i0} is the average food loss percentage of the country in the base year,
i = country, j = commodity, t = year, 0 is the base year
l_{ijt} is the loss percentage (estimated or observed) of commodity j in country i in year t,
q_{ij0} are the production quantities of commodity j in country i in the base period,
p_{j0} is the average international price of commodity j (at international \$) in the base period.

Food loss – Commodity coverage

The index covers 5 food groups and 2 commodities within each group (10 key commodities set) by country.

- Cereals & Pulses
- Fruits & Vegetables
- Roots & Tubers and Oil-bearing crops
- Animal products
- Fish and fish products

Cross-country comparisons are possible at the group level, while the key commodities within groups can differ across countries.

This is to ensure that the index is relevant to the countries while providing some degree of international comparability.

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Food loss – Commodity coverage

The default selection criterion for the commodities is to rank them by their value of production within each country and commodity group.

The default process is to:

- Compile value of production for every commodity
- Sort the commodities by group and rank them
- Select the top 2 in each group

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Table 2. 1 Food Loss Percentage Compilation example (starting from an arbitrary figure of 1000 and using fictional loss percentages) (United Nations, SDGs metadata)

Starting Amount - Agriculture production	1,000				
	Production	Transport	Storage	Wholesale	Processing
Average Losses (%)	7.3	1.5	7.7	0	3.5
Amount Lost	73	13.905	70.308	0	29.497
Amount Remaining	927	913.095	842.787	842.787	813.289

% of supply still in the market	81.3% = (813.289/1,000) *100
l_{ijt} = % lost from farm to (but not including) retail	18.7% = 100 – 81.3%

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Food loss

Additional information about quantification methods is available at Food Loss+Waste Protocol (2016) Food Loss and Waste Accounting and Reporting Standard and Food Loss+Waste Protocol (2016) Guidance on FLW Quantification Methods. Two online tools have also been developed in 2016 by the Food Loss+Waste Protocol and are available here Sample Reporting Template for FLW Standard and FLW Quantification Method Ranking Tool.

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Figure 2. 1 Loss percentage by commodity tab

Loss percentage by commodity

Group	Commodity	Unit	2000	2001	2002	2003	2004
1. Cereals & Pulses		%					
1. Cereals & Pulses		%					
2. Fruits & Vegetables		%					
2. Fruits & Vegetables		%					
3. Roots & Tubers and Oil-Bearing crops		%					
3. Roots & Tubers and Oil-Bearing crops		%					
4. Animal Products		%					
4. Animal Products		%					
5. Fish and Fish Products		%					
5. Fish and Fish Products		%					

Enter the name of each commodity here

For each year, enter the loss percentage by commodity

If there is a note, enter the reference to the right of the cell and include the note at the bottom of the table

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Production quantities by commodity

Group	Commodity	Unit	2005
1. Cereals & Pulses	-	Tonnes	
1. Cereals & Pulses	-	Tonnes	
2. Fruits & Vegetables	-	Tonnes	
2. Fruits & Vegetables	-	Tonnes	
3. Roots & Tubers and Oil-Bearing crops	-	Tonnes	
3. Roots & Tubers and Oil-Bearing crops	-	Tonnes	
4. Animal Products	-	Tonnes	
4. Animal Products	-	Tonnes	
5. Fish and Fish Products	-	Tonnes	
5. Fish and Fish Products	-	Tonnes	

The name of the commodity will appear here automatically

For 2005, enter the production quantities by commodity

If there is a note, enter the reference to the right of the cell and include the note at the bottom of the table

Notes:
- Please note that the FAO has set the base year as 2005. As base year quantities are used in the calculationn only, there are no additional years to be filled.
- Please note that the unit in this table is "**Tonnes**".
- Please provide in the Footnotes Section below information on the source and data collection

Footnotes

Code	Footnote text

Enter any note here

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Price of commodities

Group	Commodity	Unit	2005
1. Cereals & Pulses	-	$	
1. Cereals & Pulses	-	$	
2. Fruits & Vegetables	-	$	
2. Fruits & Vegetables	-	$	
3. Roots & Tubers and Oil-Bearing crops	-	$	
3. Roots & Tubers and Oil-Bearing crops	-	$	
4. Animal Products	-	$	
4. Animal Products	-	$	
5. Fish and Fish Products	-	$	
5. Fish and Fish Products	-	$	

The name of the commodity will appear here automatically

For 2005, enter the price by commodity

If there is a note, enter the reference to the right of the cell and include the note at the bottom of the table

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Average food loss percentage (FLP) and the Food Loss Index (FLI)

Group	Commodity	Unit	2005	2006				
1. Cereals & Pulses	-	%	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!
1. Cereals & Pulses	-	%	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!
2. Fruits & Vegetables	-	%	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!
2. Fruits & Vegetables	-	%	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!
3. Roots & Tubers and Oil-Bearing crops	-	%	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!
3. Roots & Tubers and Oil-Bearing crops	-	%	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!
4. Animal Products	-	%	#¡DIV/0!	#¡DIV/0!				
4. Animal Products	-	%	#¡DIV/0!	#¡DIV/0!				
5. Fish and Fish Products	-	%	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!
5. Fish and Fish Products	-	%	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!	#¡DIV/0!
Average Food Loss Percentage (FLP)		%	**#¡DIV/0!**	**#¡DIV/0!**	**#¡DIV/0!**	**#¡DIV/0!**	**#¡DIV/0!**	**#¡DIV/0!**
Food Loss Index			**#¡DIV/0!**	**#¡DIV/0!**	**#¡DIV/0!**	**#¡DIV/0!**	**#¡DIV/0!**	**#¡DIV/0!**

Notes:
• Please note that the unit in this table is "**percentage %**". The Food Loss Index has no unit.

The FLP for each commodity will appear here

The FLP will appear here

The FLI will appear here

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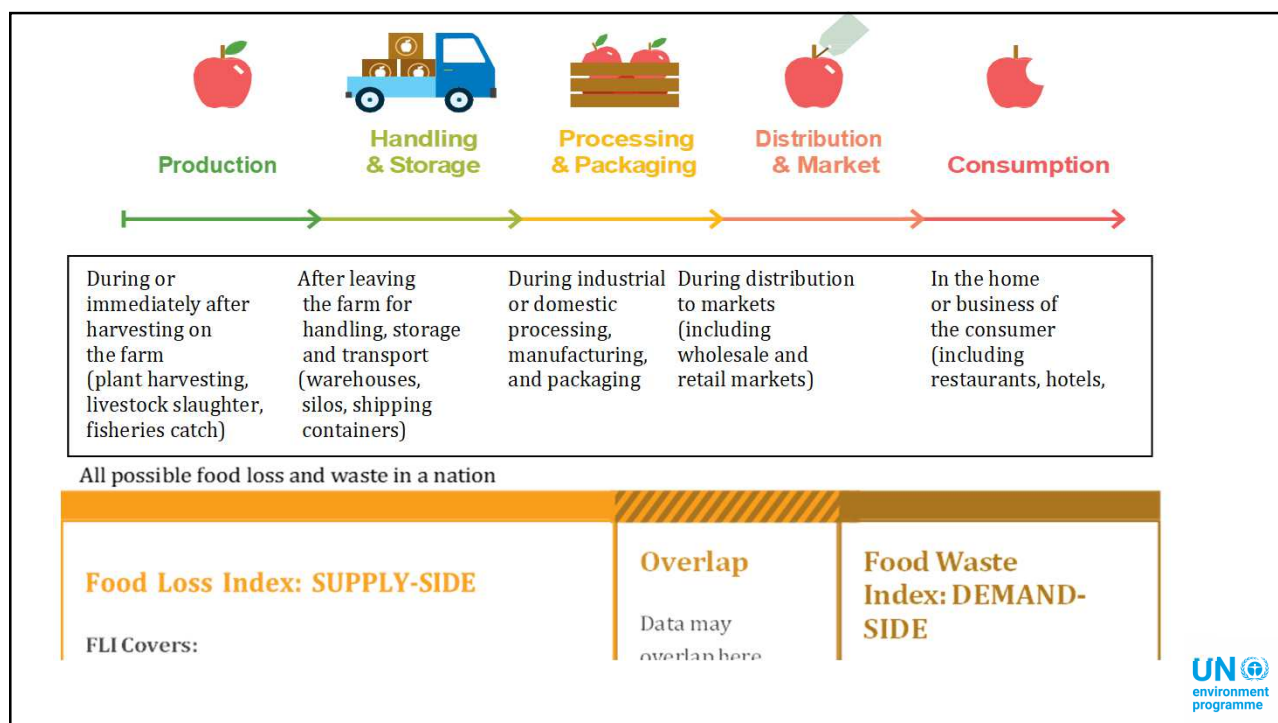
Indicator 5: Food waste index

Food waste

This indicator of circular economy corresponds to the SDG 12.3.1 (b) Food waste index.

The methodology for this indicator is based on UNSD's Metadata for 12.3.1b, UNEP's Global Chemicals and Waste Indicator Review Document (2021), and the Food Loss+Waste Protocol Food Loss and Waste Accounting and Reporting Standard (2016).

SDG target 12.3 aims 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.

Indicator 12.3.1 comprises two sub-indicators: 12.3.1a Food loss index and 12.3.1b Food waste index. The two sub-indicators cover discrete food value chain stages, but some overlap is possible at the interface of the manufacturing and retail stages

Production   Handling & Storage   Processing & Packaging   Distribution & Market   Consumption

| During or immediately after harvesting on the farm (plant harvesting, livestock slaughter, fisheries catch) | After leaving the farm for handling, storage and transport (warehouses, silos, shipping containers) | During industrial or domestic processing, manufacturing, and packaging | During distribution to markets (including wholesale and retail markets) | In the home or business of the consumer (including restaurants, hotels, |

All possible food loss and waste in a nation

| Food Loss Index: SUPPLY-SIDE   FLI Covers: | Overlap   Data may overlap here | Food Waste Index: DEMAND-SIDE |

Food waste

LEVEL I INDICATOR *Food waste estimates for each sector*	Existing data and extrapolation to other countries
LEVEL II INDICATOR *Food waste generation tracked at a national level*	Direct measurement of food waste in retail, food service and households. Sufficiently accurate for tracking.
LEVEL III INDICATOR

Additional information and disaggregation of food waste data | Additional information to inform policy and other interventions. This includes disaggregated data by destination, edible/inedible parts, and also captures manufacturing food loss not covered by the Food Loss Index (e.g. where more than one commodity is combined to produce complex food products). |

Food waste
Interpretation of the indicator (I)

A significant share of food grown for human consumption is never eaten. This inefficiency has significant economic, social and environmental impacts and is related to food insecurity.

The inedible parts associated with food (e.g. bones, rinds, pits/stones) can take up space in landfills, and contribute to GHG emissions during decomposition. These inedible parts represent a form of natural resource inefficiency (to the degree that behavioral or technological changes could transform some of them into food or other products).

The 2030 Sustainable Development Agenda has emphasized the importance of sustainable production and consumption systems as efficient food systems, on the supply side and the consumption side, contribute to food security and sustainability of natural resources since agriculture is a major user of land and water.

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Food waste
Interpretation of the indicator (II)

The indicator aims to measure the total amount of food that is wasted in tonnes.

It complements the Food Loss Index, as both indicators look to divide the food value chain and measure the efficiency of the food system.

The Food Waste indicator could guide the elaboration of a national strategy on food waste reduction and in the shift into a circular economy model.

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Food waste
Interpretation of the indicator (III)

The food waste index is calculated for each sector within a country, so the level of food waste is expressed as an index relative to the level of food waste in the baseline year.

A value of:
    100 would indicate the same level of food waste in that sector as the baseline year.
    50 would indicate that food waste in that sector had halved since the baseline year.

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Food waste
Data availability

The UNSD/UNEP Questionnaire on Environment Statistics: Waste Section has introduced a table focusing on the collection of Food Waste data as of 2024.

The questionnaire is sent out every two years to National Statistical Offices and Ministries of Environment.

Data providers for this indicator are National Statistical Offices, relevant ministries and other organisations.

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Food waste
Limitations in the use of the indicator (I)

The challenge resulting from the flexible three level methodological approach is one of consistency and comparability.

Level I cannot be compared directly. Level I data is not designed to track food waste over time in a country and should not be used to compare countries, as the data often originates from a few years ago or from other countries.

Levels II and III without caveats, as the methodologies differ substantially. Level II and III data however should enable comparison over time for a specific country, as well as comparison between countries with care.

Levels II and III data can be aggregated to regional level.

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Food waste
Limitations in the use of the indicator (II)

Food waste data reported by countries entails uncertainties.

These can come from random errors and systematic errors. Random errors can for example be sampling errors and are relatively easy to estimate, whereas systematic errors are harder to estimate and can arise by e.g. using a measurement method that systematically over-or under-estimate food waste.

Countries should report the total estimated uncertainty related to their levels II and III food waste data, as a good practice and to ensure that comparisons between countries are only made when the degree of uncertainty is sufficiently small.

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Food waste
Calculation (I)

$$Total\ food\ waste_t = FW_{Households_t} + FW_{Food\ service\ t} + FW_{Retail_t}$$

$$Food\ waste\ per\ capita_t = \frac{Total\ foodwaste_t}{Annual\ Average\ Population_t}$$

t: year

$$Food\ Waste\ Index_t = \frac{Food\ waste\ per\ capita_t}{Food\ waste\ per\ capita_{t_0}} \times 100$$

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Food waste
Calculation (II)

$$Food\ waste\ per\ capita_{t_{simp}} = \frac{MSW\ generated_t \times Share\ of\ food\ waste_t}{Annual\ Average\ Population_t}$$

t: year
MSW generated$_t$: total municipal solid waste generated in a given year
Share of food waste$_t$: proportion of total MSW made up of food waste in the year, which can b
estimated from waste composition studies.

$$Food\ Waste\ Index_{t_{simp}} = \frac{Food\ waste\ per\ capita_{t_{simp}}}{Food\ waste\ per\ capita_{t_{0_{simp}}}} \times 100$$

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Food waste

Level I Indicator

Level I proposes a method to estimate food waste for countries not able to undertake their own measurement in the short term.

The method involves a model and some other basic calculations.

The approach uses existing country data, studies carried out by countries and extrapolations based on the estimates observed in other countries for countries where no estimates are available. Lastly, confidence ratings are assigned to the estimates.

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Food waste

Level I Indicator

Most of the Level I estimates are approximate and not sufficiently accurate for observing and tracking changes over time.

However, they are sufficient to provide a snapshot of food waste generation at country level for the first time, insight into the scale of the problem, and make a case for action.

They are intended as a short-term support while governments develop capacity for national measurement (consistent with Level II).

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Food waste

Level II Indicator

This level generates primary data on actual food waste generation that will show progress (or lack thereof) over time.

It covers studies on food waste generation at the retail, household and food service stages of the food supply chain.

Countries can begin with one nationally relevant stage and complete all sectors over time.

Household food waste is recommended to be measured as a first step, as household food waste is suggested to be the largest source of food waste in most countries.

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Figure 2. 1 Food waste generation by sector tab

Food waste generation by sector

Category	Unit	2000	2001	2002	2003	2004	2005
Total food waste generation	**Tonnes**	**0.00**	**0.00**				
Retail trade (except of motor vehicles and motorcycles ISIC 47)	Tonnes						
Food service (ISIC 49-52, 55, 56, 84 and 85)	Tonnes						
Households	Tonnes						

Notes:
- Please note that the unit in this table is **"tonnes"**.
- **If the re...** ...**blank. If the requ...**
- Please ... the source and d...

For each year, enter the amount or FW generated by the retail trade sector

If there is a note, enter the reference to the right of the cell and include the note at the bottom of the table

Enter the amount or FW generated by the food service

Enter the amount or FW generated by households

Total FW generation will appear here

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Figure 2. 1 Food Waste Index Level II tab

Food Waste Index (Level II)

• If the value turns red, please check if it is correct.

Category	Unit	2000	2001	2002	2003	2004
Total food waste generation	Tonnes	0.00	0			
Population	habitants					
Food waste per capita	Tonnes/habitant	#¡DIV	#			
Food waste Index		#¡DIV/0!	#			

Enter the population for each year

Food waste per capita will appear here

Food waste index will appear here

Notes:
• Please note that the units in this table are **"Tonnes and habitants"**.

Note: When data are inserted in the Excel file tabs, some cells might turn red. This is to alert users to possible inconsistences or errors that need to be verified.

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Food waste

Level III Indicator

Level III provides additional information to inform national policy and decision-making, as well as other behaviour change interventions.

In this level, disaggregation by destination, by edible and inedible food waste, and by manufacturing, as a fourth sector, is proposed for national consideration.

It is recommended where possible that food waste is disaggregated by edible parts (intended for human consumption) and inedible parts. Note that assumptions on what constitutes inedible parts varies across and within countries (sometimes even within households).

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Food waste

Level III Indicator

The disaggregation by edible and inedible parts associated with food (e.g. animal bones, egg shells, fruit stones or pips) helps understand the amount of food waste which is unavoidable (e.g. if fresh eggs are purchased, then egg shells will need to be discarded), and how much is avoidable, in that it could have been prevented if better managed in the supply chain or the home.

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Food waste generation by sector Level III

Category	Unit	2000	2001	2002	2003	2004
Total food waste generation	Tonnes	0.00	0.00	0.00	0.00	0.00
Total food waste generated: edible parts	Tonnes	0.00				
Retail trade (except of motor vehicles and motorcycles ISIC 47)	Tonnes					
Food service (ISIC 49-52, 55, 56, 84 and 85)	Tonnes					
Households	Tonnes					
Manufacturing sector (where more than one commodity is combined to produce complex food products)	Tonnes					
Total food waste generated: inedible parts	Tonnes	0.00				
Retail trade (except of motor vehicles and motorcycles ISIC 47)	Tonnes					
Food service (ISIC 49-52, 55, 56, 84 and 85)	Tonnes					
Households	Tonnes					
Manufacturing sector (where more than one commodity is combined to produce complex food products)	Tonnes					

For each year, enter the amount or FW generated by the retail each sector, food service sector, households and manufacturing sector (edible parts)

If there is a note, enter the reference to the right of the cell and include the note at the botton of the table

For each year, enter the amount or FW generated by the retail each sector, food service sector, households, and the manufacturing sector(inedible parts)

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Food waste destination

Category	Unit	2000	2001	2002	2003
Total food waste	Tonnes	0.00	0.00	0.00	0.00
Codigestion/anaerobic digestion	Tonnes				
Composting (except home composted)/aerobic digestion	Tonnes				
Home composted	Tonnes				
Controlled combustion	Tonnes				
Land application	Tonnes				
Landfill	Tonnes				
Refuse/discards/litter	Tonnes				
Sewer/wastewater treatment	Tonnes				
Other (describe)	Tonnes				
Food reuse	Tonnes				
Animal feed	Tonnes				
Bio-based materialsw/biochemical processing	Tonnes				

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Food waste
Additional disaggregation

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Disaggregation may also be useful based on:
- Types of food (fruit, vegetables or bakery) and sub-type (e.g. type of fruit wasted)
- Geography (individual states, provinces, cities, or other areas within a country). This will help understand where efforts to reduce food waste need to be focused.
- Groups of businesses or people that waste disproportionately high or low levels of food waste or particular types of food (for example, for households disaggregation by age, gender, income level…)

Qualitative research, including interviews and observation, can be a measurement method to obtain this disaggregated information.

This disaggregation creates a more complete picture of the food waste and food surplus status within a country, and the data can contribute to a national food waste prevention strategy.

Thank you

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