

SDG indicator metadata (Harmonized metadata template - format version 1.0)

0. Indicator information

0.a. Goal

Goal 12: Ensure sustainable consumption and production patterns

0.b. Target

Target 12.3: By 2030, 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

0.c. Indicator

Indicator 12.3.1: (a) Food loss index and (b) food waste index

0.d. Series

This metadata refers only to part (a) of the indicator 12.3.1: Food loss index.

0.e. Metadata update

2021-02-16

0.f. Related indicators

SDG Sub-Indicator 12.3.1b: Food Waste Index

0.g. International organisations(s) responsible for global monitoring

The Food and Agriculture Organization of the United Nations

1. Data reporter

1.a. Organisation

The Food and Agriculture Organization of the United Nations

2. Definition, concepts, and classifications

2.a. Definition and concepts

Definitions

The Food Loss Index - Index of the changes in food loss over time. The index covers five food groups along the supply chain. The indicator is computed as a ratio of Food Loss Percentages in the current year and the Food Loss Percentages in the base year according to a standard fixed-base index formula.

Definition of food loss for SDG monitoring:

Food losses - are all the crop and livestock human-edible commodity quantities that, directly or indirectly, completely exit the post-harvest/slaughter production/supply chain by being discarded, incinerated or otherwise, and do not re-enter in any other utilization (such as animal feed, industrial use, etc.), up to, and excluding, the retail level. Losses that occur during storage, transportation and processing, also of imported quantities, are therefore all included. Losses include the commodity as a whole with its non-edible parts.

Related concepts

Food – is any substance, whether processed, semi-processed or raw, which is intended for human consumption, and includes drink, chewing gum and any substance which has been used in the manufacture, preparation or treatment of "food" but does not include cosmetics or tobacco or substances used only as drugs.

Food loss and waste (FLW) – is the decrease in quantity or quality of food.

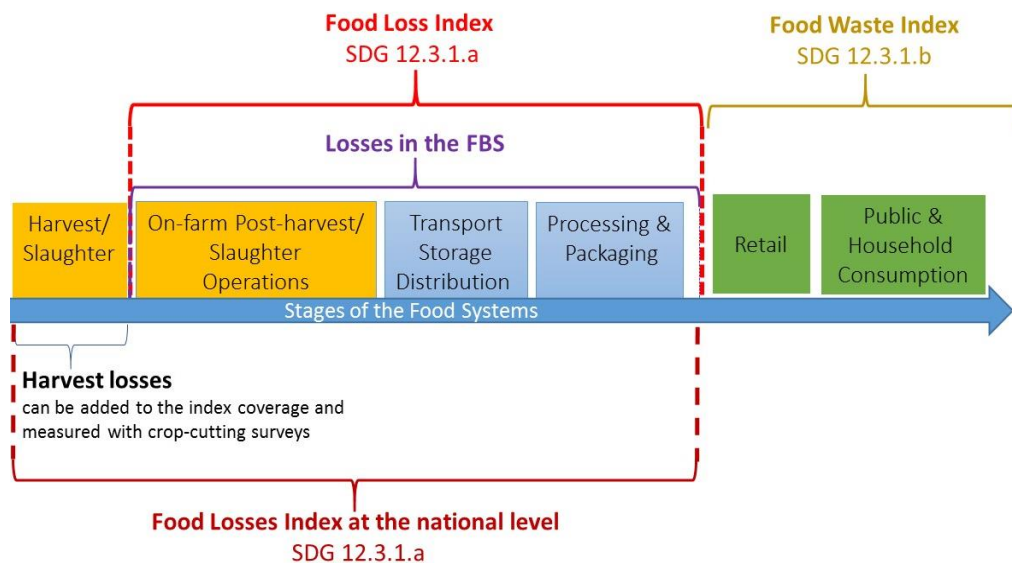
Quantitative food loss and waste – is the decrease in mass of food.

Pre-harvest constitutes the time frame between maturity and harvesting.

Harvest/slaughter/catch refers to the act of separating the food material from the site of immediate growth or production.

Food Loss Index scope and boundaries

- The scope of the Food Loss Index starts on the production site with postharvest/slaughter/catch operations up to but not including the retail level, in line with the Food Balance Sheets conceptual framework.
- The index covers five food groups and 10 key commodities set by the countries.
- Harvest losses can be included in the index at the country level only.
- Pre-harvest losses are out of scope.
- Sub-Indicator 12.3.1(b) Food Waste Index covers food waste at the retail and consumption level.



2.b. Unit of measure

The Food Loss Index has no unit of measure.

Food Loss percentages are expressed in percentage.

2.c. Classifications

CPC 2.1 expanded grouped in 5 commodity groups, namely:

1. Cereals & Pulses
2. Fruits & Vegetables
3. Roots & Tubers and Oil-Bearing crops
4. Animals Products
5. Fish and Fish Products

3. Data source type and data collection method

3.a. Data sources

- 1) Loss estimates from the Supply Utilization Accounts/Food Balance Sheets that are officially reported to FAO through the annual Agricultural Production Questionnaires.
- 2) Survey based loss percentages by commodity along the supply chain.
 - Agricultural surveys, value chain surveys, rapid appraisal methods, administrative data, business surveys.
- 3) Modelled estimates for non-reporting countries.
 - The FAO developed a food loss estimation model that uses available official data and data from scientific literature to estimate losses at the regional, food group and global level.

3.b. Data collection method

The methodology and guidelines consider a range of data collection methods to reduce the cost of data collection. The emphasis is put on the critical loss points along the value chain.

The guidelines recommend representative sample surveys to ensure statistically representative, accurate, and comparable estimates especially when the sector is characterized by a large number of small actors (for example smallholders). Countries that already have a farm survey can add a post-harvest loss (PHL) module for the sake of cost-efficiency.

Food loss data collection can be interview based (subjective approach) or measurement based (objective approach), the former method is less costly but leads to under-estimation.

3.c. Data collection calendar

The guidelines recommend carrying out loss surveys every three to five years, with lighter surveys in between based on declarations, as loss ratios tend to be stable, from one year to the next under normal conditions. The recommendation is also to add a loss module to existing surveys. The data collection calendar will therefore follow the calendar of the main survey.

To establish a baseline, it is recommended to carry out two or three consecutive comprehensive PHL surveys to establish a first solid set of preliminary estimates. Since estimates limited to a single year have a higher risk of being biased because of the occurrence of specific events (e.g. that are weather-related), as compared to estimates based on two- or three-year averages.

Loss estimates for the compiling Supply Utilization Accounts should be carried out every year.

3.d. Data release calendar

Loss data collection is taking place through FAO's annual Agriculture Production Questionnaire in May every year.

A separate data collection exercise took place in 2019 after the indicator had been upgraded to gather all the previously available information.

Loss data is released in FAOSTAT in December every year.

3.e. Data providers

National Statistical Offices
Statistical Units of the Ministry of Agriculture

3.f. Data compilers

Food and Agricultural Organization of the United Nations, Statistics Division, Methodological Innovation Team and the Crop Livestock Food Balance Sheet team.

3.g. Institutional mandate

Article I of the FAO constitution requires that the Organization collect, analyses, interpret and disseminate information relating to nutrition, food and agriculture
<http://www.fao.org/3/K8024E/K8024E.pdf>

4. Other methodological considerations

4.a. Rationale

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 resource since agriculture is a major user of land and water.

The food loss and food waste index look at the entire supply chain and the trend in structural losses. The Food Loss Index monitors progress on the supply side of food chains, as it measures if the share of agriculture production that does not reach the retail stage in 2030 has increased or decreased with respect to the base period and by how much. The numerator of the indicator indicates the level of losses and informs on the magnitude of the problem.

A greater efficiency of the food supply chain also has implications for all producers whether looking at efficiency in large-scale producers for export markets or in small-scale production units relevant for poverty and food insecurity reduction goals.

4.b. Comment and limitations

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

A major limitation is data availability. The reported data accounts for a small percentage of the data needs: only 23 countries out of 185 reported on losses in 2016 for one commodity or more. The number of reporting countries was 42 in 2018 and 12 in 2019. As for the data

only 7%% of loss factors in the SUA/FBS database are officially reported, all others being estimated.

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

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 however, most countries lack the capacity and resources to carry out this exercise. A suite of statistical and modelling tools combined where possible with administrative records will have to be used.

4.c. Method of computation

Computation Method:

SDG 12.3 for a single country, called Food Loss Index (FLI), is a fixed-based index as follows:

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

Where:

- 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} is 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.

For the FLI and FLP, the weights are the value of production at international dollar prices. The weight is fixed in the reference year.

Commodity Coverage

The index covers five food groups and two commodities within each group:

1. Cereals & Pulses

2. Fruits & Vegetables
3. Roots & Tubers and Oil-Bearing crops
4. Animals Products
5. Fish and Fish Products.

Cross-country comparisons are possible at the group level, while the key commodities within groups can differ across countries. This, to ensure that the index is relevant to the countries while providing some degree of international comparability.

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

The default selection process is based on value of the commodity in international dollar prices in the base period. At national level, countries can use their own set of values, quantities or prices, or use different policy-based criteria, as long as the main headings are covered.

Compiling a commodity food loss percentage: aggregating loss percentages along the supply chain

The FLI covers losses at the national level from production to the retail stage. Using the index notation, these percentage losses of each commodity are the l_{ijt} where:

l_{ijt} is the loss percentage (estimated or observed) of commodity j in country i year t

When loss estimates are available separately for the various stages of the value chain, they need to be aggregated into an overall percentage with the following simplified and standardized supply chain:



It is expected that the losses at each stage of the value chain are nationally representative.

The overall percentage of production that does not reach the retail stage (l_{ijt}) can be obtained with the simplified process below, illustrated in the table:

1. Set a Starting Amount of product, 1000 tons in the example
2. Compile the Amount Lost at each stage by multiplying the Average Losses (%) of that stage to the reference quantity. The reference quantity is 1000 at the Production stage; in the other stages the reference quantity is the Amount Remaining from the previous stage.
3. Compile the Amount Remaining at each stage by subtracting the Amount Lost from the Amount Remaining of the previous stage.
4. Compile the percentage of supply still in the market at the end of the chain as the ratio of the last Amount Remaining and the Starting Amount.
5. Compile the loss percentage of the commodity l_{ijt} as the difference between the 100 and the % of supply still in the market

Starting Amount - Agriculture production	1000				
	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	$81.3\% = (813.289/1000) * 100$				
l_{ijt} = % lost from farm to (but not including) retail	$18.7\% = 100 - 81.3\%$				

4.d. Validation

Data sources for agricultural production and on-farm losses are mainly national agricultural surveys that are conducted by the Ministry of Agricultural/Livestock and/or the National Statistical Office. The surveys are usually annual, and in the absence of direct measurements, data are interview-based. Agricultural censuses, which FAO recommends conducting every ten years, may be the only available source of loss estimates in a number of countries that do not carry out annual surveys. Off-farm loss data along the value chain may be obtained through specialized surveys (supplemented by research) through the national agri-food industry system.

The data are provided in the Agriculture Production Questionnaire, in the Utilization sections used to compile Supply Utilization Accounts.

Utilizations of interest here are those quantities destined for, among others, animal feed, for industrial uses (e.g. biofuel production), for national/enterprise/farm stocks, for seed (sowing for the successive agricultural cycle) – to be able to infer on quality and economic losses, that are not covered by the definition and data collection, and to assess the overall data consistency in the validation phase.

These datasets (production, trade and utilizations including losses), once cross-checked and validated, form the basis for the compilation of the Food Balance Sheets (FBS). The FBS are an accounting framework whereby supply (production + imports + stock withdrawals) should equal utilization (export + food processing + feed + seed + industrial use + losses, etc.). It should be noted that, within the FBS framework, post-harvest/slaughter losses (up to the retail level) are considered as utilization, and thus a component in the balancing of the FBS. The FBS framework provides a snapshot of the agricultural supply situation at the national level, and allows for a cross-referenced structure whereby data, official or estimated/imputed, may be further analyzed and validated (e.g. animal numbers may result as being under-reported/estimated).

The new FBS Guidelines for national compilation (completed recently in collaboration with the Global Strategy) and new compilation tool (R-based ‘shiny’ application).

Detail on FBS methodology: <http://www.fao.org/economic/ess/fbs/ess-fbs02/en/>.

The FBS Handbook shown here should not be confused with the recently completed FBS Guidelines. The Handbook is of a more technical nature and explains the methodology followed by FAO in compiling country FBS. The Guidelines on the other hand, while based on the Handbook, provide countries with a more revised and practical guidance and recommendations for compilation at the national level.

Some FBS background text also available on FAOSTAT:
<http://www.fao.org/faostat/en/#data/FBS>.

4.e. Adjustments

There are no adjustments to the international classifications except for items in the Fish group, because the CPC is not used for FAO’s fish production statistics.

Fish and fish products are classified as per FAO’s Food Balance Sheet ICS categories as follows: Cephalopods (2766), Crustaceans (2765), Demersal Fish (2762), Freshwater Fish (2761), Marine Fish, Other (2764), Molluscs, Other (2767), Pelagic Fish (2763), Fish, Seafood (2960), Aquatic Animals, Others (2769), Aquatic Plants (2775), Meat, Aquatic Mammals (2768), Aquatic Products, Other (2961).

The FLI food groups are further aggregations of CPC groups.

4.f. Treatment of missing values (i) at country level and (ii) at regional level

- **At country level**

In the absence of food loss data at the country-commodity level, FAO developed a loss imputation model to estimate losses of all countries and commodities and compile the Food Loss Index for SDG regions and commodity groups.

The model builds on loss data provided by the countries to the FAO within the annual Agriculture Production Questionnaires, loss factors available in the scientific literature published in the [FLW database](#) and from case studies, and a set of 200+ explanatory variables.

The model is a fixed effect model that selects the explanatory variables with a random forest algorithm. Where there is no information at all for a country-commodity combination, the model is applied to a cluster of commodities and the countries' estimated loss percentages will be equal to the cluster's at global level.

- **At regional and global levels**

When loss data is insufficient to estimate even one country-commodity combination, the countries' estimated loss percentages will be equal to the cluster's at global level for all the ten commodities in that country basket.

4.g. Regional aggregations

At regional and global level, the GFLI is computed as:

$$GFLI_t = \frac{\sum_{i=1}^G FLL_{it} * w_i}{\sum_{i=1}^G w_i} * 100$$

by aggregating country indices using weights equal to the total value of agricultural production of each country (in the region or the world) in the base year.

4.h. Methods and guidance available to countries for the compilation of the data at the national level

The main source of loss data at the national level are:

- Official reports of loss estimates in the commodity balance sheets, Supply Utilization Accounts or Food Balance Sheets

Data sources for agricultural production and on-farm losses are mainly national agricultural surveys that are conducted by the Ministry of Agricultural/Livestock and/or the National

Statistical Office. The surveys are usually annual, and in the absence of direct measurements, results are based on interview-based data on lost quantities of crop, animals and animal products. Agricultural censuses, which FAO recommends conducting every ten years, may be the only available source of loss estimates in a number of countries that do not carry out annual surveys. Off-farm loss data along the value chain may be obtained through specialized surveys (supplemented by research) through the national agri-food industry system.

The Methodology for monitoring SDG Target 12.3 :

<http://www.fao.org/3/CA2640EN/ca2640en.pdf> has been published as a guide for countries in calculating the index along with a method to aggregate data from subnational stages of the supply chain to the national level. Subnational disaggregation will identify where losses occur and the scope of impact, sets the focus on where to make investments and aids in targeting intervention strategies and policies to decrease food losses along the supply chains.

The Guidelines for the measurement of harvest and post-harvest losses of grain produced by the Global Strategy are available at <http://gsars.org/en/guidelines-on-the-measurement-of-harvest-and-post-harvest-losses/> with an on-line training course available at <http://gsars.org/en/training-course-on-post-harvest-losses-english/#more-3855> . Additional material is available at <http://www.fao.org/sustainable-development-goals/indicators/1231/en/>

Other important documents that can guide countries in the measurement and compilation of the FLI are:

Reports on pilot testing the FLI : <http://www.fao.org/3/ca6691en/ca6691en.pdf>

E-learning course on SDG Sub-Indicator 12.3.1a :
<https://elearning.fao.org/course/view.php?id=605>

4.i. Quality management

FAO Statistics Division processes production, trade and food balance sheet data in an integrated Statistical Working System following the GSBPM.

Data in each domain are managed and processed with a set of modules and R scripts for data editing, outlier detection, imputation of missing data, compilation of derived indicators, aggregation, validation and compilation of quality indicators.

FAO Statistics Division engages with the countries during processing and validation.

4.j Quality assurance

For FAO, a sound statistical basis is essential in monitoring progress towards national and international development goals and targets. To ensure quality standards are maintained, the organization developed a Quality Assurance Framework for the FAO Statistics system (FAO SQAF) consisting of a quality framework and a mechanism to ensure the compliance of FAO statistics to the quality framework itself. The SQAF is available at <http://www.fao.org/3/i3664e/i3664e.pdf>.

With respect to officially reported loss data submitted by countries through the annual Agriculture Production Questionnaire, loss data is validated during the whole Supply Utilization Account/Food Balance Sheet processing and validation that entails a purely statistical approach based on outlier detection tests and validation routines and a consultative approach where countries are requested for additional information or clarifications. The same approach applies to the data received in 2019 through the ad hoc questionnaire on “Food Losses from Production to the Retail stage”.

More generally FAO complies with “Guidelines on global data flows” approved by UNSC 2018 for the national data submitted to FAO for the SDGs Indicators Database. With respect to losses that is extremely scarce dataset (7% of reported records in FAOSTAT in the period 1990-2016), and to the extent that country data has to be estimated with an econometric model, the estimates are validated with countries via an email asking for an authorization to publish them.

The available basic data still does not allow for the publication of the Food Loss Index at the country level but only at the regional level by commodity groups.

4.k Quality assessment

Datasets (production, trade and utilizations), once cross-checked and validated, form the basis for the compilation of the Food Balance Sheets (FBS). The FBS are an accounting framework whereby supply (production + imports + stock withdrawals) should equal utilization (export + food processing + feed + seed + industrial use, etc.). It should be noted that, within the FBS framework, post-harvest/slaughter losses (up to the retail level) are considered as utilization, and thus a component in the balancing of the FBS. The FBS framework provides a snapshot of the agricultural supply situation at the national level, and allows for a cross-referenced structure whereby data, official or estimated/imputed, may be further analyzed and validated (e.g. animal numbers may result as being under-reported/estimated).

5. Data availability and disaggregation

Data Availability

Modelled regional estimates are available for the five commodity groups

Disaggregation

Sub-indicator 12.3.1 must be disaggregated by product and stage of the supply chain at the country level. 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, processors), economic sectors (small-holders or traditional sector versus large and commercial farms/firms).

6. Comparability / deviation from international standards

Not yet applicable

7. References and Documentation

FAO, Methodology for Monitoring SDG Target 12.3 :

<http://www.fao.org/3/CA2640EN/ca2640en.pdf>

FAO, Definitional framework of food loss 2014:

http://www.ipcinfo.org/fileadmin/user_upload/save-food/PDF/FLW_Definition_and_Scope_2014.pdf

GSARS, "Guidelines on the measurement of harvest and post-harvest losses",

<http://gsars.org/wp-content/uploads/2018/06/GS-PHL-GUIDELINES-completo-09.pdf> , 2018.

FAO, "FAOSTAT Commodity Definitions and Correspondences," n.d.

<http://www.fao.org/economic/ess/ess-standards/commodity/comm-chapters/en/>.

SDG indicator metadata

(Harmonized metadata template - format version 1.0)

0. Indicator information

0.a. Goal

Goal 12: Ensure sustainable consumption and production patterns

0.b. Target

Target 12.3: By 2030, 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

0.c. Indicator

Indicator 12.3.1: (a) Food loss index and (b) food waste index

0.d. Series

0.e. Metadata update

2021-02-05

0.f. Related indicators

11.6.1, 12.5.1

0.g. International organisations(s) responsible for global monitoring

United Nations Environment Programme (UNEP)

1. Data reporter

1.a. Organisation

United Nations Environment Programme (UNEP)

2. Definition, concepts, and classifications

2.a. Definition and concepts

Definitions:

The indicator aims to measure the total amount of food that is wasted in tonnes. It complements SDG 12.3.1(a) on Food Loss (which is under the custodianship of FAO). Both indicators look to divide the food value chain and measure the efficiency of the food system.

Level I indicators	
<i>Food waste in the waste stream</i>	Estimated from a global model, based on regional coefficients for food waste in the total waste stream.
Level II indicators	
<i>Food waste generation by supply chain stage</i>	Collect data on food waste generation from supply chain stages based on national priorities

A full methodology for this indicator is available in the document entitled, “Global Chemicals and Waste Indicator Review Document (UNEP, forthcoming)”.

Concepts:

Food: Any substance—whether processed, semi-processed, or raw—that is intended for human consumption. “Food” includes drink and any substance that has been used in the manufacture, preparation, or treatment of food. “Food” also includes material that 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.

Inedible (or non-edible) parts: Components associated with a food that, in a particular food supply chain, are not intended to be consumed by humans. Examples of inedible parts associated with food could include bones, rinds, and pits/stones. “Inedible parts” do not include packaging. What is considered inedible varies among users (e.g., chicken feet are consumed in some food supply chains but not others), changes over time, and is influenced by a range of variables including culture, socio-economic factors, availability, price, technological advances, international trade, and geography.

Municipal Solid Waste (MSW) includes waste originating from households, commerce, and trade, small businesses, office buildings and institutions (schools, hospitals, government buildings). It also includes bulky waste (e.g., old furniture, mattresses) and waste from selected municipal services, e.g., waste from park and garden maintenance, waste from street cleaning services (street sweepings, the content of litter containers, market cleansing waste), if managed as waste. Further information on municipal solid waste is defined in the SDG indicator methodology for 11.6.1.

2.b. Unit of measure

Percent

Tonnes

KG

2.c. Classifications

3. Data source type and data collection method

3.a. Data sources

1. Data provided by national governments, including NSOs and Ministries of Environment

3.b. Data collection method

UNEP is exploring the use of the UNSD/UNEP Questionnaire on Environment Statistics for data collection. Additional data will be collected through directly by UNEP.

3.c. Data collection calendar

The UNSD/UNEP Questionnaire is every 2 years.

3.d. Data release calendar

1. First SDG reporting cycle: 2021

3.e. Data providers

National Statistical Systems

3.f. Data compilers

UNSD and UNEP

3.g. Institutional mandate

4. Other methodological considerations

4.a. Rationale

According to an FAO publication in 2011, approximately one-third of all food is lost or wasted. This results in economic loss and increased pressure on food systems. Reducing food waste is critical to maximizing the value of agricultural land and ensuring that natural resources are used in a sustainable way. This indicator will not only help countries identify where food is lost and wasted but also it can provide information which Governments, citizens and the private sector can take in order to reduce food waste.

4.b. Comment and limitations

The challenge resulting from the flexible three-level approach to presenting a methodology is one of consistency and comparability. Can one compare between levels or across methods? Not directly and not without caveats. It is possible to compare at regional levels where the random error is relatively high (e.g. around 25%) for each country but it would not be appropriate to compare countries against each other unless there was a much greater difference in their estimates than the combined amount of error. The approach to consistency is one of transparency against a framework.

Different methods of quantification can also be used for other relevant and related purposes (for example, “where are the greatest opportunities within the waste that is produced to reduce it?”). Taking in-home consumption as an example, it is difficult to obtain reasons for discarding food (and therefore the opportunities for influencing citizen behaviour) without the use of diaries or ethnography. However, direct weighing of waste volumes could give a significantly more accurate quantity.

4.c. Method of computation

A full methodology for this indicator is available in the document entitled, “Global Chemicals and Waste Indicator Review Document (UNEP, forthcoming)”.

For the purpose of this indicator, the methodology aims to estimate the amount of food in total waste stream.

For level 1, the global modelling approach will estimate a proportion of food in the total waste stream data (e.g. municipal solid waste, MSW) and apply the proportion to the total. The work on

this model will utilize the existing efforts to compile information for SDG 11.6.1 on municipal solid waste management and will utilize existing information on global waste, including World Bank publication “What a Waste 2.0, A Global Snapshot of Solid Waste Management to 2050”. Some countries publish data on the ratio of food waste to the total MSW. The existing data will be used to create a regional coefficient for each SDG sub-region. These regional coefficients will then be applied to the data for 11.6.1 and What a Waste data to fill data gaps. (Not that when a country reports data then no global estimation will be done, the country data will be used directly.)

For level 2, countries should identify the scope of which stages of the supply chain can be covered and estimate the total amount of food wasted for each supply chain stream. The amount of food waste within a stage of the food supply chain shall be established by measuring food waste generated by a sample of food business operators or households in accordance with any of the following methods or a combination of those methods or any other method equivalent in terms of relevance, representativeness and reliability.

Stages of the food supply chain	Methods of measurement				
Primary production	- Direct measurement	-Mass balance		-Questionnaires and interviews	
Processing and manufacturing				-Coefficients and production statistics	
Retail and other distribution of food			-Waste composition analysis	-Counting/ scanning	
Restaurants and food services					-Diaries
Households					

The food waste index is calculated according to the following approach:

$$\text{Food waste per capita}_t = \frac{\text{Total foodwaste}_t}{\text{Population}_t}$$

where:

t = year

total food waste is the sum of waste in four sectors in a given year as per the formula below:

$$\text{Total food waste}_t = \text{FW}_{\text{in households}_t} + \text{FW}_{\text{Restaurants and food services}_t} + \text{FW}_{\text{Retail}_t} + \text{FW}_{\text{Manufacture}_t}$$

The Food Waste Index for the year in question is then calculated as food waste per capita in that year divided by food waste per capita in a baseline year (t_0) multiplied by 100 to express the result as a percentage:

$$\text{Food Waste Index}_t = \frac{\text{Food waste per capita}_t}{\text{Food waste per capita}_{t_0}} \times 100$$

In countries where it is not possible to obtain the detailed data necessary to estimate total food waste using the formula above, a simplified approach to calculating food waste per capita may be taken:

$$\text{Food waste per capita}_{t_{\text{simp}}} = \frac{\text{MSW generated}_t \times \text{Share of food waste}_t}{\text{Population}_t}$$

where:

t = year

$MSW_{generated_t}$ is total municipal solid waste generated in a given year (as calculated for Indicator 11.6.1)

$Share\ of\ food\ waste_t$ is the proportion of total MSW made up of food waste in the year, which can be estimated from waste composition studies

The food waste index for the year is then calculated using the simplified estimate of food waste per capita in the same formula as above

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

4.d. Validation

UNSD carries out extensive data validation procedures that include built-in automated procedures, manual checks and cross-references to national sources of data. Communication is carried out with countries for clarification and validation of data. Only data that are considered accurate or those confirmed by countries during the validation process are included in UNSD's environment statistics database and disseminated on UNSD's website

4.e. Adjustments

4.f. Treatment of missing values (i) at country level and (ii) at regional level

Missing values are not imputed for national figures. However, UNEP is using a global modelling approach for level 1 (this is due to the lack of data on this topic and the interest in having data that can be used for high-level tracking).

4.g. Regional aggregations

The data will be aggregated at the sub-regional, regional and global levels. For the aggregation methods, please see: http://wesr.unep.org/media/docs/graphs/aggregation_methods.pdf.

4.h. Methods and guidance available to countries for the compilation of the data at the national level

Global Chemicals and Waste Indicator Review Document (UNEP, forthcoming)

4.i. Quality management

4.j Quality assurance

4.k Quality assessment

5. Data availability and disaggregation

Data availability:

All countries that reply to the questionnaire.

Time series:

The UNSD/UNEP Questionnaire is sent to countries every 2 years requesting annual data.

Disaggregation:

Ideally, food waste would be disaggregated by edible and inedible parts (Note that it is important to take into account the difference between countries in terms of inedible parts. Nicholes et al. provides some insight into differences between countries.

Disaggregation of food waste by destination is important for understanding the best way to optimize the use of food waste for fertilizer. This includes:

- Co-digestion/anaerobic digestion,
- Composting/aerobic process,
- Controlled combustion,
- Land application,
- Landfill,
- Refuse/discards/litter,

6. Comparability / deviation from international standards

Sources of discrepancies:

As mentioned, waste statistics involve a large number of national and sub-national stakeholders which may create discrepancies. Additionally, there are a number of challenges related to the following:

- Variations in waste over time can have a significant impact on estimated quantities of waste when short studies (e.g. a week) are used to represent a longer time period (a year)
- The specific time of year when a study takes place which may affect the waste produced;
- Natural variation over time in amounts of waste generated by single entities (e.g. households or restaurants).
- At a national level, countries may have to rely on other entities to measure their own waste and report to the government, which would then be collated and analysed to estimate the total amount. How the data is collected would vary by the food chain stage as the way food waste is generated in each stage varies. For example, a large formal retailer (supermarket chain) may keep records of stock unsold and discarded which could be reported. On the other hand, a government requesting reporting from households may have to issue guidance to local municipalities and prescribe a quantification method e.g. a food waste diary. The reported quantities may require scaling if a government cannot obtain reports from the entire population of the food chain stage i.e. it is unlikely that every household in the country would report.

7. References and Documentation

Global Chemicals and Waste Indicator Review Document (UNEP, forthcoming)