

Goal 12: Ensure sustainable consumption and production patterns

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

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

This metadata refers only to part (a) of the indicator 12.3.1: Food loss index. Methodology for part (b): food waste index is still under development.

Institutional information

Organization(s):

Food and Agriculture Organization of the United Nations

Concepts and definitions

Definition:

Index of the changes in the food losses percentages along the supply chain of key commodities over time.

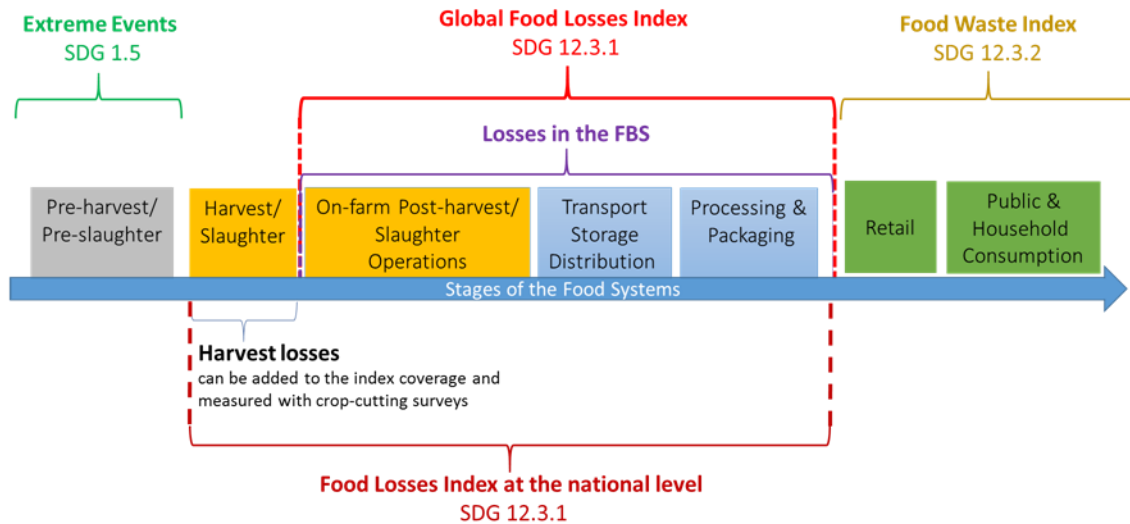
The indicator is computed as a ratio of Food Loss Percentages in the current year and the Food Loss Percentages in the base year according to a standard fixed-base index formula.

FAO proposes to define food losses to be measured in the framework of SDG indicator 12.3.1 (a) as:

- 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.

The Food Loss Index scope within food chains is described as follows:

- The Food Loss Index for SDG monitoring and reporting purposes will be aligned with the Food Balance Sheets framework, starting with postharvest operations on the farm up to but not including the retail level,
- The scope of the index at the national level narrows down to 10 key commodities set by the countries in five headings for comparability.
- At country level, countries can include harvest losses in the scope of the index through ad hoc surveys and by adjusting the concept of production.
- Pre-harvest losses are covered by Target 1.5. Moreover, pre-harvest losses refer to the concept of potential production that cannot be used for the indicator.
- A separate Food Waste Index is being developed to cover food waste at the retail and consumption level.



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 indicator looks at the trend in structural losses. It 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 has also 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.

Concepts:

The following concepts are adopted for the calculation of indicator 12.3.1:

- **Quantitative food loss and waste** – is the decrease in mass of food (FAO's Conceptual Framework for Food Losses and Waste).
- **Loss** takes place from the point of maturity up to but excluding the retail stage (the meaning of 'maturity' for livestock and fish must be defined). For the indicator and the data collected loss is measured in percentage terms (id).
- **Agriculture production** data for crops refer to the actual harvested production from the field orchard or garden, excluding harvesting and threshing losses and that part of crop not harvested for any reason.
- The **value of production** which serves as weights is equal to production quantities multiplied by a reference price. The reference prices used in the GFLI are international dollar prices calculated using the Geary Khamis equation method and based on FAOSTAT production and produce price data. Value of production is also the default selection criteria for the ten key commodities by country.
- The FLI is based on the international **Central Product Classification** version 2.1 expanded. Commodities are then grouped according to FAO's Food Groups used in the Supply Utilization Accounts and Food Balance Sheets and further grouped into fine main categories.

Comments 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 and only 4.4% of loss factors in the SUA/FBS database are officially reported, all others being estimated

The index is limited in scope as harvest losses cannot be included in the international indicator for comparability reasons. Moreover, the index covers ten key commodities in each country, because requesting regular loss data for a larger number of crops would be a difficult and unsustainable exercise for most countries.

The index covers quantitative losses only, that challenging enough to measure. Qualitative and economic losses are also very relevant but less consistent out of the scope of the indicator.

This indicator is particularly challenging for countries because it requires several surveys to collect all the necessary information along the 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.

Methodology

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, the GFLI will cover the top 10 commodities in five main categories
- t = year, 0 is the base year
- l_{ijt} is the loss percentage (estimated or observed) of commodity j in country i year t
- q_{ij0} is the production quantities by country, commodity in the base period
- p_{j0} is the average 2004-2006 international price by commodity (at international \$)

The weights for the GFLI reflect the economic importance of the country's agricultural value of production at international dollar prices relative to the rest of the world¹. For the FLI and FLP, the weights are the value of the focus commodities at international dollar prices. The weight is fixed in the reference year. The weighting pattern was chosen based on the efficiency of markets operating in economic terms,

¹ The method for compiling international dollar prices is described in FAO (1993)

rather than based on contribution to diets (caloric or protein value), environmental factors or other non-market valued opportunity costs.

Commodity Coverage

One of the challenges in effectively measuring the progress of the FLI is the coverage of commodities. Countries will not be able to measure losses of all commodities in their production system and the key commodities can differ across countries, while international comparability is needed. The proposal for the index to cover ten commodities by country in five groups ensures the index relevance to the countries while providing some degree of international comparability.

The default selection criterion for the priority commodities and the related FLI is to rank commodities by value of production in within each country and commodity group. The default process is to:

- Compile value of production for every commodity
- Group commodities by category 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 year. 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.

The five main headings, with two commodities per heading are:

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

Aggregating the loss percentages along the value chain for each commodity, country and year

The objective of the FLI is to estimate losses at the national level from production to the retail level in line with the Food Balance Sheet conceptual framework. Using the index notation, these percentage losses are the l_{ijt} where:

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

When losses are not estimated for the entire tract of the supply chain, they can be broken by stage of the value chain. It is expected that the losses at each stage of the value chain are nationally representative, but that there are underlying distributions of different actors at each stage. The best method for estimating losses and ensuring comparability across stages and time is a sample survey using objective measurement.



A simplified process is proposed to standardize losses and aggregate losses along the supply chain to obtain the overall percentage of production that does not reach the retail stage. The process assumes that *measured* losses at each point are independent of each other and works in the following way:

- The percentage along the stages in the supply chain are applied to a reference quantity and subtracted from the remainder of the previous stage's amount. This enables to take into account imports at the various stages of the supply chain (primary products at wholesale level, semi-processed products for further processing, etc.).
- At the end of the supply chain the remainder is then divided by the original reference quantity to convert back to a percentage.

Starting Amount - Agriculture production	1000				
	Farm	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 total supply still in the market	$81.3\% = (813.289/1000) * 100$				
% lost from farm to (but not including) retail	$18.7\% = (1-0.813)*100$				

Table 1. Aggregation of Maize Loss percentages along the supply chain

The 18.7% in the table would then be the reported quantity for that supply chain, for the country in the given year. This percentage would be applied to the production to calculate the quantity of losses to be reported in the Food Balance Sheets. The loss percentage would also be used in the Food Loss Index for the country, an applied to the base weights and then can be compared to the loss percentages times the weights in the base year to analyze the trends over time.

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).

Treatment of missing values:

- [At country level](#)

When no food loss is available at the country-commodity level, FAO developed a loss imputation model to estimate losses of all countries and commodities and compile the Global 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 and from case studies, and a set of 200+ explanatory variables.

The model is a fixed effect model that selects the explanatory variables using 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.

Regional aggregates:

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.

Sources of discrepancies:

Not yet applicable

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 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/>

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>.

Quality assurance

For FAO, a sound statistical basis is essential in monitoring progress towards national and international development goals and targets. To this end, 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.

In 2019, the available basic data still did not allow for the publication of the Food Loss Index at the country level but only at the regional level by commodity groups.

Data Sources

Description:

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

The loss section needs to be strengthened and broken down by stage of the value chain. For this reason it is foreseen that a separate data collection exercise may start after the indicator has been up-graded.

Data Availability

Description:

Not yet applicable. Some data is provided from available suitable surveys in selected countries

Calendar

Data collection:

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

The loss section needs to be strengthened and broken down by stage of the value chain. For this reason a separate data collection exercise took place in 2019 after the indicator had been up-graded.

Data release:

To be determined

Data providers

Given the various data sources, national data providers vary. Official information on food commodity production and utilization used by FAO to compile Food Balance Sheets is provided mainly by Statistical Units of the Ministry of Agriculture or the National Statistical Offices.

Data compilers

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

References

FAO, "FAO Approach for Monitoring SDG12.3: Measuring & Estimating Losses for Compiling the Global Food Loss Index", Office of the Chief Statistician and Statistics Division, FAO, Rome, <http://www.fao.org/3/CA2640EN/ca2640en.pdf>

FAO, "Definitional framework of food loss," 2014, http://www.fao.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/>.

URL:

References:

Related indicators

NA.