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METHODOLOGICAL DEVELOPMENTS IN SDG INDICATORS 2.4.1 “PROPORTION OF AGRICULTURAL AREA UNDER PRODUCTIVE AND SUSTAINABLE AGRICULTURE” AND 12.3.1 “GLOBAL FOOD LOSS INDEX”

By

(2.4.1: Arbab Asfandiyar Khan, Economist and Amy Heyman, Program Officer)

(12.3.1: Alicia English and Carola Fabi, Statisticians)

FAO Office of the Chief Statistician

Summary

The paper is divided into two separate sections:

Section ‘A’ provides description of the steps involved in developing SDG indicator 2.4.1 and highlights the definition, scope, coverage, themes, sub-indicators, sustainability criteria, aggregation methods, data collection tools, country tests and next steps for implementation and monitoring of the indicator at a country level.

Section ‘B’ describes the Global Food Loss Index developed by FAO to monitor food losses in SDG indicator 12.3 and how it is built: scope and coverage, selection of basket, weighting pattern, base period and interpretation of the index. The paper further delves into methods for data collection by FAO and at country level and provides high level information on country support.

Section A: Sustainable Agriculture (Indicator 2.4.1)

AI. Introduction

This section focuses on the SDG indicator for Target 2.4 concerning sustainable food production systems. Target 2.4 is one of eight targets under Goal 2, which is dedicated to ending hunger, achieving food security and improved nutrition and promoting sustainable agriculture.” Specifically Target 2.4 states that:

“By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.”

Target 2.4 links closely to other SDG target, including 2.3 on agricultural productivity and incomes of small-scale food producers and 2.5 on the maintenance of genetic diversity. Other targets under Goal 2 focus on the health outcomes of hunger and lack of food security (such as undernourishment and stunting) and on the economic structures surrounding food production (such as research and investment, markets and trade and price volatility).

AII. Development of the indicator

Definition

In March 2016 the IAEG-SDG endorsed a methodological note submitted by FAO and which proposes to define SDG Indicator 2.4.1 as the proportion of agricultural area under productive and sustainable agriculture. Since then, FAO – together with the Global Strategy to Improve Agriculture and Rural Statistics (GSARS) – engaged in extensive research and consultation in order to develop the methodology for this indicator. It is based on the definition of sustainable agriculture agreed on by FAO’s Council in 1988: “the management and conservation of the natural resource base, and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generation. Such development conserves land, water, plant and animal genetic resources, is environmentally non-degrading, technically appropriate, economically viable and socially acceptable” ([FAO, 1988](#)).

Methodological development of the indicator has relied on a literature review ([Hayati, 2017](#)) and a series of consultation processes. The literature review confirmed that a multi-dimensional indicator, based on a series of sub-indicators, is needed in order to capture the several facets of sustainability. A Technical Meeting was convened in December 2016 involving a number of experts in sustainable agriculture to select a set of the most relevant sub-indicators to measure indicator 2.4.1. The results of that meeting were drawn together to complete a first draft of the methodological paper. The draft was first presented to the February 2017 meeting of the Scientific Advisory Committee (SAC) of the GSARS. On the basis of their feedback, an updated draft was prepared and submitted to an Expert Group Meeting (EGM) on indicator 2.4.1 held in Rome from April 3-5, 2017 ([summary report](#)). The EGM gathered agriculture statisticians from a number of countries representing all regions (Brazil, Burkina Faso, China, Indonesia, Italy, Kyrgyz Republic, Uganda, and the United States); civil society and private sector representatives; as well as thematic experts from academia and international organizations. The EGM provided guidance for further development of SDG 2.4.1, including a refined set of sub-indicators and methodologies for aggregating them into a single indicator.

Indicator 2.4.1 is defined as the:

“Proportion of agricultural area under productive and sustainable agriculture”

Formula:

$$\text{SDG 2.4.1} = \frac{\text{Area under productive and sustainable agriculture}}{\text{Agricultural Area}}$$

Where:

Agricultural area = arable land + permanent crops + permanent meadows and pastures

- The denominator agricultural area is the sum of arable land, area of permanent crops, permanent meadows and pastures.
- The numerator captures the three dimensions of sustainable production: environmental, economic and social. It corresponds to agricultural area of the farms that satisfy sub-indicators selected across all three dimensions.

Linkages with any other Goals and Targets

This indicator is linked to several other targets and indicators, including 1.1 and 1.2 (eradication of poverty); 2.3 (agricultural productivity and income); 2.5 (agricultural biodiversity); 5.a (gender equality and ownership of land); 6.3 (water quality); 6.4 (water scarcity); 15.3 (land degradation).

Terminologies used in developing indicator SDG 2.4.1

The proposed methodology uses the following terminology:

- Indicator: Overall measure of sustainable agriculture
- Dimension: Broad areas encompassed by the indicator (e.g. economic, environmental, social)
- Themes: Specific areas within a dimension (e.g. productivity, water health, well-being, etc.)
- Sub-indicators: Measures of a theme
- Variables: Components of the sub-indicator

Method of computation

In order to capture the multidimensional aspects associated with sustainability, the indicator was developed by:

1. establishing a dashboard of sub-indicators for selected themes across the three dimensions of sustainability; and,
2. from this set of sub-indicators, deriving an aggregate indicator, capable of reflecting the proportion of agricultural area under productive and sustainable agriculture.

For each dimension of sustainability, three themes have been identified as most representative of sustainability issues. These themes have been selected on the basis of a literature review and several rounds of expert meetings. The proposed themes and sub-indicators are presented in Table 1. In total there are nine themes and 10 sub-indicators (one for each theme, except in the case of water, described

by two sub-indicators: one on water use and one on water quality). These sub-indicators are described in detail in the methodological sheets provided as supporting documents in the reference sections. The methodological sheets provide descriptions of the relevance, definition, data and measurement issues.

The approach adopted is that appropriate criteria to assess sustainability are developed for each sub-indicator against which the observed value of the sub-indicator can be compared. The comparison of observed and criteria values provides the assessment of sustainability for a given sub-indicator.

Proposals for sustainability assessment criteria are provided in the respective methodology data sheets for each sub-indicator in the document, ‘Sub-indicator Methodological Sheets (FAO 2017)’. Following the general method for establishing the sustainability criteria listed in Table 1, it is expected that each country will assess the sustainability of its agriculture in an internationally comparable way. Some sub-indicators are relative so that they can capture variations in countries’ economic, social and environmental conditions (i.e. relative efficiency to measure productivity). For other sub-indicators, the criteria are generic and not country specific (i.e. zero and above for net farm income; zero groundwater depletion for water use, etc.)

Table 1: Themes, sub-indicators and proposed sustainability criteria for computing SDG 2.4.1

Dimensions	No	Themes	Sub-indicators	Proposed sustainability criteria
Economic	1	Land productivity	Farm output value per farm agricultural area	Above one third of the 90th percentile
	2	Farm profitability	Net farm income	Zero and above
	3	Financial resilience	Access to financial services	Access to at least one of the financial services
Environmental	4	Soil health	Soil health	At least half of farm not affected by soil degradation
	5	Water health	Water use	No inter-annual trend detected in groundwater level over last 5 years
			Water quality	Nitrogen concentration in rivers and aquifers below 50 mg/l
6	Biodiversity	Heterogeneity of agricultural landscape	Shannon Evenness Index above 0.3, Average patch size lower than 2 ha and Edge density below 0.01	
Social	7	Decent work	Wage rate in agriculture	Equal to or above the international poverty line
	8	Well-being	Agricultural household income	Equal to or above the international poverty line
	9	Access to land	Secure rights to land tenure	Positive response to at least one of the secure rights conditions

Computation of the aggregate indicator is then done by assessing the sustainability performance of a farm with respect to each of the sub-indicators across the three dimensions using “One Out All Out” (OOAO) approach. Where the sustainability assessments against sub indicators across all dimensions are considered acceptable (i.e. meets the sustainability criteria), then the farm is considered sustainable and its agriculture area will contribute positively to the overall aggregate indicator at national level¹.

The SDG 2.4.1 indicator is obtained by dividing the area of sustainable agriculture by the total agricultural area:

¹ Alternative aggregation approaches have been considered and are described in the document, “Methodological concept note (FAO 2017)”. One of them is the Dimension Based Approach” meaning that for each dimension (i.e. economic, environmental and social), the farm is considered productive and sustainable when 2 of the 3 themes for that dimension are assessed as having sustainable performance relative to its criteria and when all dimensions are assessed as productive and sustainable.

$$SDG\ 2.4.1_{OOAO} = \frac{AA_{sust}}{AA} * 100$$

Where AA refers to agricultural area.

Using notation, the total area under productive and sustainable agriculture is equal to the intersection of the agricultural areas that are economically, socially and environmentally sustainable. Assuming one sub-indicator per dimension, and using the notation above, indicator SDG 2.4.1 can thus be expressed as:

$$SDG\ 2.4.1_{OOAO} = \frac{AA_{eco-sust} \cap AA_{soc-sust} \cap AA_{env-sust}}{AA}$$

Where

AA = Total agricultural Area

$AA_{eco-sust}$ = Agricultural area economically sustainable

$AA_{soc-sust}$ = Agricultural area socially sustainable

$AA_{env-sust}$ = Agricultural area environmentally sustainable

where there are three themes for each dimension, sustainability for that dimension is represented as for the economic dimension (as equivalently for the other dimensions):

$$AA_{eco-sust} = AA_{sub1} \cap AA_{sub2} \cap AA_{sub3}$$

Where

AA_{sub1} = Sustainable agricultural area according to sub indicator of theme 1

AA_{sub2} = Sustainable agricultural area according to sub indicator of theme 2

AA_{sub3} = Sustainable agricultural area according to sub indicator of theme 3

In order to operationalize the estimation, the following formula could be used:

$$SDG\ 2.4.1 = \frac{\sum_{i=1}^n AA_i * S_i}{\sum_{i=1}^n AA_i}$$

Where:

AA_i = Agricultural area of farm i

S_i = General assessment of sustainability of farm i

$S_i = 0$ when at least one sub-indicator is considered not sustainable

$S_i = 1$ when all sub-indicators are considered sustainable or not applicable

Disaggregation

Indicator 2.4.1 is expected to be collected through farm surveys and the result expressed as a national value. However, the methodology is scale independent and can be adopted at any geographical level. In addition the indicator can be disaggregated according to type of activity and other characteristics of the farm e.g. size.

The sustainability of agricultural area will be assessed by dimension, and themes and results will be compiled accordingly.

Sources and data collection

This indicator is measured at farm level, and most of the required information will be collected through a single data collection vehicle, a farm survey. In some cases, however, information from monitoring systems or remote sensing is needed for attributing results to the farm.

Data provider

In many countries, the National Statistical Office will coordinate collection of the data. This will most likely require coordinating across ministries or other national sources of data and bringing together the requisite data. In particular, environmental data will require accessing information from monitoring network and remote sensing.

Data compiler

FAO is the custodian agency for compilation and reporting on this indicator at the global level.

Comments and limitations

The key principles that have been applied in developing the indicator are: policy relevance and “action-ability”; universality; comparability; measurability and cost effectiveness, with special attention on limiting reporting burden for countries. This has influenced the choice of a limited number of sub-indicators for different dimensions and the level of sophistication in data collection.

For the purposes of SDG reporting and consistent application across countries, it has been considered that impact/outcome indicators should be the focus of measurement, rather than measuring a set of possible sustainable ‘practices’ (but noting that indicators that measure practices may be useful in certain situations). The main reason for this choice is that impact/outcome indicators are more objective than indicators based on practices. Judging on the sustainability of a practices is likely to vary from one place to another, and from one farm type to another, and what can be considered sustainable in one setting may not be suitable in another.

Because the unit of measure for SDG 2.4.1 is the farm and its agricultural area, sustainability aspects beyond the farm are not covered. Such aspects that are not considered include food security; land distribution; land-use changes; quality of the agricultural outputs; nutrition; transportation, storage, processing, and marketing; sustainability of the supply chain or international trade.

Piloting and global consultation

Pilot studies are currently taking place in five countries (Kyrgyz Republic, Rwanda, Italy, Bangladesh and Ecuador). The goal is to test the documentation and metadata that has been prepared to accompany this process, making sure it is clear and complete.

Briefly the tests aim to assess:

- Availability and quality of data
- Feasibility of building the sub-indicators
- Correlation among the sub-indicators
- Sensitivity of the results to threshold values
- Compilation of the aggregate 2.4.1 indicator according to alternative approaches

The methodology documents are also the subject of an online global consultation in order to build international consensus by countries vis-à-vis National Statistical Offices around this indicator. The results of this consultation, which will be completed by the end of October, will be available before the IAEG-SDG meeting in November 2017.

AIII. Next steps

The following steps are envisioned moving forward for indicator 2.4.1:

- Training workshop and global consultation (November 2017)
- Development of questionnaire and instruction manual (toolkit in 1st half of 2018)
- Field tests of data collection instrument
- Development of data processing procedures
- Preparation of guidelines (2018)
- Development of training material including e-learning (2018)
- Initiate support to countries to measure the indicator at country level (2018)

Section ‘B’: Global Food Loss Index

BI. Introduction

The objective of the Sustainable Development Goal (SDG) 12 is to ‘Ensure sustainable consumption and production patterns’, with Target 12.3 stating that “By 2030, 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.”

To monitor progress against 12.3 Target objectively, FAO is proposing two separate indicators, one on food losses and one on food waste, as the nature of the target with its two distinctly worded components, waste and loss, implies the identification of two separate aspects of an efficient supply chain. While the two concepts are related and the precise boundaries between them may be blurred conceptually, for operational clarity and measurement and to bring more effective and efficient outcomes, it is necessary to separate the components and is important in the definition of the indicator. The indicator for waste will be forthcoming after further methodological development and consultation, both internally and externally.

The two proposed indicators to measure the target adequately would therefore, focus on the ‘reduction of losses along the food production and supply chains’ (supply oriented) and the second to measure the ‘halving per capita global food waste at the retail and consumer level’ (demand oriented). Additionally, whereas better measurement is also needed on pre-harvest and losses related to extreme events and can be measured concurrently, they are covered under different SDG objectives. To identify the segments of the supply chain and to delineate activities in Figure 1.

To date, a Global Food Loss Index (GFLI) has been adopted by the United Nations Statistical Commission as part of the revised indicators framework. The purpose of the index is to allow for policy makers to look at the positive and negative trends in food loss over time, with a base year of 2005. Analyzing the trend (versus the level) allows for policies to be developed that alter the structure of the food supply system to improve its efficiency against food losses and not focusing on short-term variability and fluctuations at a micro-level. The objective of this paper is to present the structure of the GFLI and the progress FAO has made on the measuring and monitoring aspects of the SDG 12.3 target.

BII. Development of the topic

Global Food Loss Indicator (GFLI)

The index is a composite of commodities that are key in agricultural production systems, including crops, livestock, and fisheries. Analytically speaking, GFLI is obtained by weighting average of the

single indexes calculated for all world countries. These single indices are transformations of the Food Loss Percentages (FLP). The percentages which will help countries assessing the magnitude of the problem relative to the international context, whereas, the index will help discern the trend of structural losses compared to a base year.

In order to track losses without compounding production variability, losses are expressed as a percentage and are aggregated using fixed quantities and prices. A country's Food Loss Percentage can be interpreted as the average percentage of supply that does not reach the retail stage.

Price weights are the International Dollar prices regularly compiled by the FAO for its Agricultural Production Index Number using the Geary-Khamis method². The Geary-Khamis method for establishing international prices was used up to the late 1980's for GDP comparison in the International Comparison Programme. It consists of a system of simultaneous equations which produce a set of average international prices after conversion into international dollar using purchasing power parities endogenously obtained.

The aggregate Food Loss Percentage (FLP) for a country *i*, in a year *t* is defined as follows:

$$FLP_{it} = \frac{\sum_j l_{ijt} * q_{ij2005} * p_{j2005}}{\sum_j q_{ij2005} * p_{j2005}} * 100$$

Where:

j = commodity

2005 is the base year³

l_{ijt} is the loss percentage (estimated or observed)

q_{ij2005} are the average 2004-2006 production quantities by country

p_{j2005} is the average 2004-2006 international price by commodity (at international \$)⁴

The single indexes, called Food Loss Indices (FLI), are synthetic fixed-based quantity indices defined as follows:

$$FLI_{it} = \frac{FLP_{it}}{FLP_{i2005}} = \frac{\sum_j l_{ijt} * q_{ij2005} * p_{j2005}}{\sum_j l_{ij2005} * q_{ij2005} * p_{j2005}} * 100$$

Where:

i = country, *j* = commodity, *t* = year

2005 is the base year

l_{ijt} is the loss percentage (estimated or observed)

q_{ij2005} is the average 2004-2006 production quantities by country, centered on the year 2005

p_{j2005} is the average 2004-2006 international price by commodity (at international \$), centered on the year 2005

The FLI shows the relative change in percentage food loss in commodities *j*, for country *i* over time *t*, compared to a base period.

The variable *l_{ijt}*, can be either measured directly through nationally representative loss estimates from sample surveys along the supply chain or modeled through the methodology provided herein. The reference year is set by the international community, though for the current iteration the reference

² Rao, P., (1993), "Inter-country comparison of agricultural output and productivity", FAO Economic and Social Development Paper N.112.

³ The base year will be replaced with 2015 as soon as the price series for 2016 is published

⁴ At national level, countries can use national prices and production figures.

year is 2005. The set quantities and prices come from surveys and data collected by the countries averaged over three years.

To aggregate the FLI into the global (GFLI) or a regional (RFLI) index, the country indices are aggregated using weights equal to the total value of agricultural production in the base period.

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

Concurrently, the FLP can be aggregated into a Global Food Loss Percentage (GFLP) or a regional (RFLP) percentage as follows, using weights equal to the total value of agricultural production in the base year:

$$GFLP_t = \frac{\sum_{i=1}^G FLP_{it} * w_i}{\sum_{i=1}^G w_i}$$

Interpreting the change of the GFLI over time is assessed by how much the index moves from the base year value of 100. If overall percent of food losses in the selected commodities has decreased by 10 %, the index will return a value of 90 in the analyzed year. As the weights are fixed in the base year for the FLI, the index will indicate structural changes in the efficiency of the food system for the commodities selected. The weights on the GLFI are based on the contribution of agricultural production value for the country to the global food system. For an aggregation for the SDG Regions, in the SDG monitoring objectives, the weight refers to the contribution of an individual country's to the region's value.

As countries collect additional sources of data, it will become apparent that there will likely be a minimum threshold in which losses are not socially or economically efficient to reduce below. Additionally, there will be thresholds in which losses above a certain percent require less production overall in the market. For example in the cases where farmers don't see an economic benefit from harvesting crops in the field or where farmers are incentivized not to produce. Accounting in this way, would allow for governments to assess the value of each additional unit of currency of expenditure on losses as it approaches a social or economic optima. However, addressing these minima and how countries may choose them, are above the scope of this document.

Weights

The weights for the GFLI reflect the economic importance the countries overall value of agricultural production at international dollar prices to the rest of the world. For the FLI, the weights are also the value of the commodities at international dollar prices, but relative to the country's commodities basket. The weight is fixed in the reference year.

The weight was chosen based on the efficiency of markets operating in economic terms, rather than based on contribution to diets (caloric or protein value), environmental factors or other non-market valued opportunity costs⁵. If countries wish to measure against these factors, the countries can, within the selection of commodities by food group heading in the international index or for inclusion in the national commodity baskets. If there are known market failures (e.g. under availability of carbohydrates or proteins due to physical damage, lack of access, price distortions, affordability issues, etc.) then countries can work towards remedying these market failures and the impacts of which can be measured tangibly in percentage of losses across the commodities.

⁵ Other weighting schemes may be considered beyond the GFLI for SDG Reporting, including weights on caloric value, resource use, or other environmental related variables, but the data in some of these other weights lack coverage or may overtly bias the index towards specific commodities.

Comparability

One of the challenges in effectively measuring the progress of the GFLI is the coverage of commodities. The purchasing power parity index (PPP) was considered as the good practice of what framework may be possible for international commodity based comparisons. The PPP's framework in the International Comparison Programme uses representative commodities and provides the structure for using commodity headings as a means of aggregating similar commodities in order to do global comparisons.

Selection of commodities

For the national objectives the recommendation is that countries focus on the top 10 commodities that meet their national objectives within the five commodity headings of the indicator, with two commodities by heading. The proposed headings are: Cereals & Pulses, Fruits & Vegetables, Roots & Tubers, Other Crops (Oil-Bearing, Sugar, Stimulants, Spices), Animals Products & Fish and Fish Products.

The recommendation is to use the value of production as the selection factor⁶ but countries have the flexibility to select the top economic and the top staple commodities; or those that have the highest resource demands.

The definitions of the commodity trees and the full listing of commodities under each heading can be found in FAOSTAT commodity definitions and correspondences⁷.

The underlying assumption to this selection process is that commodities within the same heading are comparable and that there is equivalence in importance between them. For example, in the roots and tubers group the selection of potatoes and cassava are on equal standing at the global level. Additionally, it assumes that there is equivalence in losses among different varieties within the product headings. Both of these are simplifying assumptions in order to decrease the burden on countries for undertaking fewer nationally representative supply chain studies, and focusing their efforts and resources on the most critical commodities.

Approach to data collection by FAO

Data collection by FAO will take place through FAO's annual Agriculture Production Questionnaires (APQ), thus adding no reporting burden to the countries. The APQ has a section on selected products utilizations, which include losses. Few additional questions and metadata will be added on harvest losses and the method used for the estimates.

Approach to data collection by the countries and country assistance

The second stage needed to progress on the SDG measuring and monitoring is to improve the data available to policy makers. In order to allow countries to measure and monitor progress on the SDG target, FAO has a two-pronged approach: 1) improve the collection of data, both along the supply chain and the calculation of loss at the national level; 2) impute losses for non-reporting countries based on methodology developed and presented in.

⁶ The full product list and the commodities baskets by country are available in appendix to FAO Proposal for monitoring SDG12.3: Measuring & Estimating Losses for Compiling the Global Food Loss Index (2017)

⁷ United Nations Food and Agriculture Organization UNFAO, "FAOSTAT Commodity Definitions and Correspondences," n.d., <http://www.fao.org/economic/ess/ess-standards/commodity/comm-chapters/en/>.

In order to improve data availability and quality, FAO has developed guidelines for measuring losses and setting nationally representative samples. The “Guidelines on cost-effective methods for estimating harvest and post-harvest losses for grains (cereals and pulses)”, will be published under the aegis of the Global Strategy and will be in press and available in 2018. The guidelines will cover operational concepts and definitions, sampling methodology and alternative measurement methods. These guidelines will be complemented by appendixes on fruits and vegetables, livestock and fish products published directly by FAO.

Regional seminars and an e-learning course will be used to transfer knowledge to regional and national partners on the recommended methods, as well as on SDG 12.3 reporting and monitoring. Moreover, FAO will support countries at their request in the implementation of the recommended PHL estimation methods. Statistics Division is also aiming at strengthening the data-driven component of other FAO or international partners’ projects.

Peer review global consultation

The methodology documents have been presented to 22 Asian countries in September 2017 and at an External Consultation organized by FAO at the end of September 2017 including 8 country representatives from all regions and 9 international partners. The documents are also the subject of an online global consultation in order to build international consensus by countries vis-à-vis National Statistical Offices around this indicator. The results of this consultation, which will be completed by the end of October, will be available before the IAEG-SDG meeting in November 2017.

BIII. Conclusions and recommendations

The following steps are envisioned moving forward for indicator 12.3.1:

- Global consultation (November 2017)
- Improvement of existing questionnaire and instruction manual (first half of 2018)
- Training workshop (first half of 2018)
- Publication of guidelines (2018)
- Development of training material including e-learning (first half of 2018)
- Initiate support to countries to measure the indicator at country level (2018)

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