Food and Agriculture Organization of the United Nations

SDG INDICATOR 2.4.1

PROPORTION OF AGRICULTURAL AREA UNDER PRODUCTIVE AND SUSTAINABLE AGRICULTURE

Methodological concept note

18 October 2017

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1. Introduction

Background to SDG indicators

In September 2015, the United Nations General Assembly adopted the 2030 Development Agenda and an associated 17 Sustainable Development Goals (SDGs). The resultant SDGs are accompanied by 169 targets under the various goals and a set of 230 indicators to monitor progress toward the SDGs has been established.

There is a high recognition of the importance of measurement and the relevance of data in supporting progress towards the SDGs. Responsibility for the development of indicators is given to the United Nations Statistical Commission (UNSC) which established an Inter-Agency Expert Group for SDG indicators (IAEG-SDG) comprising 28 member countries.

While the international system of official statistics is embodied in the UNSC and member countries, in practice the measurement and international reporting of the comprehensive set of SDG topics is coordinated through a range of international agencies. These agencies, including the OECD, WHO, FAO, IMF, World Bank, ILO, have developed statistical and measurement expertise in the particular areas that fall within their broader roles. FAO, for example, has led the development of international measurement in agriculture, forestry, fisheries, water, soil and related topics such as food security and rural livelihoods. Recognizing this, under the auspices of the IAEG-SDG, various agencies were given "custodianship" for the finalization of the appropriate indicators for the different SDG targets and for the co-ordination of data collection following endorsement of the indicators, including leading the co-ordination with other international agencies.

In light of FAO's extensive history of data collection and development across a wide range of SDG relevant targets, it was given custodianship of 21 indicators across 6 SDGs. For more information see http://www.fao.org/sustainable-development-goals/tracking-progress/en/.

Among the large number of SDG indicators, some of the indicators are based on currently established methods and data (Tier I); others have methods but data collection is more limited (Tier II); and finally there are indicators for which agreed definitions and methods need to be developed (Tier III). The indicator for sustainable agriculture currently falls into this final Tier III category. The development and testing of the methods described in this document support the consideration of this indicator as a Tier II indicator.

Target 2.4: Sustainable agriculture

This document focuses on the indicator for Target 2.4 concerning sustainable food production systems. Target 2.4 is one of eight targets under Goal 2: End hunger; achieve food security and improved nutrition and promote sustainable agriculture. Specifically Target 2.4 is to:

> "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 progress in relation to Target 2.3 on agricultural productivity and incomes of small-scale food producers and Target 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).

Process for developing an indicator for Target 2.4

Led by FAO and done in collaboration with the Global Strategy on Agricultural and Rural Statistics (GSARS), work progressed through 2015 - 17 to establish a suitable indicator for Target 2.4. The results of this process were encapsulated in a two page methodology note (see Annex 1) that was submitted by FAO to the IAEG-SDG and endorsed in March 2016. It defines the Indicator 2.4.1 as the:

Proportion of agricultural area under productive and sustainable agriculture

The methodological note described, in broad terms, an approach to the measurement of this indicator of which the most challenging is the definition of productive and sustainable agriculture.

Through 2016 research continued with the main output a broad ranging literature review on approaches to the measurement of sustainable agriculture (Hayati, 2017) conducted by the Global Strategy to Improve Agriculture and Rural Statistics (GSARS). A key aspect of all approaches to measuring sustainable agriculture is the recognition that sustainability is a multi-dimensional concept, and therefore agreement on the coverage of different themes and sub-indicators within the indicator. To this end a technical meeting was convened in December 2016 involving a number of experts in sustainable agriculture to establish priority areas for measurement for indicator 2.4.1.

The results of that meeting were drawn together to complete a first draft of this methodological paper. That draft was first presented to the February 2017 meeting of the Scientific Advisory Committee (SAC) of the GSARS. Utilizing their feedback an updated draft was completed to support discussion at the Expert Group Meeting (EGM) on indicator 2.4.1 held in Rome from 3-5 April, 2017. The EGM gathered agriculture statisticians from eight countries across all regions, civil society and private sector representatives, as well as thematic experts from academia and from FAO Technical Departments. The purpose of the expert meeting was to review the methodology developed and to provide guidance on the approach, the dimensions, themes and sub-indicators offered for discussion, as well as the modalities to construct indicator 2.4.1.

A key aspect in the development of the method to construct indicator 2.4.1, was the selection of relevant themes, sub-indicators and the sustainability criteria for each sub-indicator. Following the EGM, detailed descriptions of methods for sub-indicators across all three dimensions of sustainability – economic, environmental and social – were developed and the overall methodological document was further refined. On the basis of research and discussion, in particular involving engagement with sub-indicator specific experts, a set of documentation was developed to support testing of the indicator in selected countries. Country testing was initiated in September 2017. It includes a review of available data in countries (October 2017), a workshop gathering country teams (November 2017) to review the methodology and address specific issues, and further testing in countries through farm survey (December 2017-February 2018).

This draft of the methodological concept note for indicator 2.4.1 is accompanied by the document for country testing and detailed methodological sheets for individual sub-indicators.

2. The concept of sustainable agriculture

Sustainable development and sustainable agriculture

At the heart of the concept of sustainability is the notion of balance over the long term among a full range of aspects concerning human activity on Earth. Thus, while there are 17 distinct SDG goals, they are, at the same time, seen as providing coverage for an integrated challenge. Meeting this challenge will require taking a systems-based perspective on how the different aspects combine.

Most commonly, sustainability is considered in the context of three dimensions – economic, environmental and social – but other dimensions may be considered such as resilience and governance. Depending on the location and circumstance, any one of the dimensions may be in or out of balance such that a situation or activity is considered unsustainable. A discussion on the choice of dimensions for this indicator is presented in the following section.

While the issue of sustainability is not new, discussion of the concept at the international level was especially renewed at the 1992 Rio Summit on Sustainable Development, which came in the wake of the release of the 1987 Brundtland Commission report. The discussion of sustainable development in international and national policy circles at that time was wide ranging and many sectors took it upon themselves to considerably extend discussion of sustainability at a sector level. Agriculture was no exception. The literature review (Hayati, 2017) highlights the broad range of approaches that have been developed in an attempt to measure sustainable agriculture.

The approaches to framing and defining sustainable agriculture vary in terms of their coverage of the three primary dimensions of sustainability, i.e. economic, environmental and social, and in terms of the scale that which they assess sustainability, i.e. from field and farm scales, to national and global scales. Some approaches consider different features of sustainability, for example whether current practices are economically feasible, environmentally sound and socially desirable. Many approaches to considering sustainable agriculture focus on particular practices such as organic, regenerative or low-input agriculture and can equate these with sustainable agriculture.

The conclusion from the literature review is that the multi-dimensional approach developed by FAO in 1988 is a meaningful framing of the concept. Thus, sustainable agriculture can be considered as:

> "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 (in agriculture, forestry and fishing etc.) conserves land, water, plant and animal genetic resources, environmentally non-degrading, technically appropriate, economically viable and socially acceptable." (FAO, 1988)

More recently, in 2014, the FAO built on these broad principles embodied in this definition of sustainable agriculture, to describe a vision for sustainable food and agriculture. Recognizing the current "unprecedented confluence of pressures" including poverty and hunger, inadequate diets, land and water scarcity, loss of biodiversity and the effects of climate change, the FAO described a vision based on five principles applicable across five sectors: crops, livestock, forestry, aquaculture and fisheries. The five principles (FAO, 2014) are:

- Improving efficiency in the use of resources is crucial to sustainable agriculture.
- Sustainability requires direct action to conserve, protect and enhance natural resources

- Agriculture that fails to protect and improve rural livelihoods, equity and social well-being is unsustainable
- Enhanced resilience of people, communities and ecosystems is key to sustainable agriculture
- Sustainable food and agriculture requires responsible and effective governance mechanisms.

Internal and external perspectives

In consideration of the approaches to sustainable agriculture it is possible to discern an internal and an external perspective on sustainability. An internal perspective takes a view of sustainability that focuses on those economic, environmental and social aspects that might be considered more direct inputs, for example, water and labour for the sustainable production of crops. Put differently, an internal perspective considers whether a farmer has sufficient economic, environmental and social resources to continue to operate well into the future.

An external perspective takes a view of sustainability that considers the sustainability of agricultural practices in a broader context, for example in terms of the off-farm environmental impacts of agricultural activities or societal perceptions on the use of traditional farming practices.

Internal and external perspectives on sustainability exist along a continuum but it is not difficult to imagine that, even within a generous framing of sustainable agriculture as supplied in the 1988 FAO definition above, there will be quite different considerations as to what should be the issues of primary focus within the economic, environmental and social dimensions.

The idea of internal and external perspectives on sustainability is particularly important when reaching a determination on whether a given situation (set of farming practices) is sustainable. As noted above, sustainability requires a balance to be found for the long term, as well as ensuring that current economic, environmental and social outcomes are appropriate. How these requirements can be described will depend directly on whether the agricultural activities are being considered in some degree of isolation or within a broader, more dynamic social, economic and environmental context. For example, farming in a particular region might be considered sustainable - provided that there are no changes to the number of water users. The measurement of sustainability from a farm level perspective is therefore not simply a question of identifying a set of relevant themes. It should also take into consideration the changing internal and external circumstances faced by the farmer.

At the extreme, using a very complete external perspective, would potentially imply taking into consideration all of the SDGs in the context of sustainable agriculture, and thus recognizing that everything is linked to everything else. However, this step is well beyond the intention and capacity for conceptualization and measurement.

Given this, the measurement approach outlined here involves describing a suitable measurement boundary, beyond a purely internal view of agriculture but limited to certain specific external connections. Thus, the indicator should be able to be considered in the context of other SDG indicators in a relatively non-overlapping manner. For those looking to consider the sustainability of agriculture in very broad contexts, it will be relevant to use additional information and indicators.

3. The approach to measuring sustainable agriculture

Broad approaches to measuring sustainability

Given the array of conceptualizations of sustainable agriculture noted above and brought together in the literature review (Hayati, 2017), there is an associated array of measurement approaches. To navigate the different approaches the following terminology is applied:

- **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

Traditional approaches to measuring sustainable agriculture can be characterized into two approaches that may be applied at both small scale (field and farm levels) and large scale (national and global levels). The first approach is establishing indicator sets or "**dashboards**" covering a number of dimensions and themes within a given definition of sustainable agriculture. This approach does not involve making an explicit, "bottom-line" estimate of sustainability but rather brings together relevant information to aid in the assessment process.

The second approach is to establish a single indicator of sustainability. From a measurement perspective, there is currently no single conceptual framing of sustainability that provides an aggregate measure of sustainability that takes into account the variety of dimensions and themes. Thus, in order to establish a single indicator it is necessary to bring together data on the selected dimensions and themes in some way. This is commonly referred to as a **composite index**, where the index is usually obtained by lumping together the scores obtained for each dimension. One concern about composite indexes is that the overall movement of the indicator may reflect both positive and negative movements in the various sub-indicators. Potentially then, one large positive movement in one dimension or theme might offset a series of smaller negative movements in other themes, and hence the composite indicator result may provide misleading signals. As sustainability is about finding an acceptable balance between the three dimensions of sustainability, such index is not suitable to measure sustainability in agriculture.

Approach to measuring sustainability for SDG 2.4.1

The proposal explained in this paper involves establishing:

i. a dashboard of sub-indicators for selected themes across the three dimensions and,
ii. from this set of sub-indicators, deriving an aggregate measure of sustainability to reflect the proportion of agricultural area under productive and sustainable agriculture.

The proposed dashboard of sub-indicators covering the three dimensions – economic, environmental and social – is intended to provide an underpinning database for monitoring progress toward sustainable agriculture. The vast array of indicators that have been developed in relation to sustainable agriculture means that there is considerable choice available, at least conceptually, in terms of measuring sustainable agriculture. As described below, a number of criteria have been considered to determine the set of dashboard sub-indicators.

The proposed aggregate indicator is not a composite index such as described above. Rather it is based on assessment of the sustainability performance of a farm with respect to each of the sub-indicators across the three dimensions. Where the sustainability assessments against each dimension are

considered desirable, then the total area of the farm is considered sustainable and that total area will contribute positively to the overall aggregate indicator at national level.

Overview of steps involved

Compiling a sustainable agriculture dashboard and deriving an aggregate indicator involves seven key steps. This short overview provides a structure for the remainder of the paper.

1. Choosing the **scale** for sustainability assessment: The choice made for indicator 2.4.1 is farm level with aggregation to higher levels.

2. Determining the **scope** of activities: The choice made for indicator 2.4.1 is to focus on crops and livestock production thus excluding forestry, fisheries and aquaculture. Other issues concerning the measurement scope for the indicator also need to be considered, e.g. the treatment of subsistence agriculture.

3. Determining coverage of **dimensions**: The choice made for indicator 2.4.1 is to include environmental, economic and social dimensions in the sustainability assessment.

4. Selecting the **themes** within each dimension: Nine themes have been selected to form the indicator 2.4.1, three from each of the dimensions.

5. Choosing a **sub-indicator** for each theme: The aim here is to identify sub-indicators that are focused on the measurement of outcomes rather than measurement of agricultural practices or farmers' perceptions. The sub-indicators should also satisfy a number of criteria (e.g. relevance for policy making, universality, measurability and cost effectiveness, etc.). The set of sub-indicators will establish the dashboard and form the basis for the derivation of the overall indicator.

6. Assessing **sustainability performance at farm level**: Specific criteria of sustainability is applied in order to declare the status of sustainability of the farm for each theme according to the respective sub-indicators. These assessments will generate an aggregate indicator of sustainability at farm level.

7. Deriving **aggregate measures of sustainability**: Based on farm level assessments, results for regional and national levels can be derived using appropriate scaling factors, generally based on agricultural area (hectares) of the farms.

Although these steps are presented in a linear fashion, in practice, a degree of iteration was required through processes of discussion and investigation. This is especially the case for steps 5 and 6 in which the description of the relevant approach for assessing sustainability performance depends on the sub-indicator, but by the same token, the choice of sub-indicator will likely be closely informed by the interpretation of sustainability that is appropriate.

Potential tabulations of indicator 2.4.1

Before examining each of these steps in more detail, it is important to recall that the broad intention in constructing this indicator is to provide information to support policy discussion and implementation. There is always a risk in discussion of an indicator of this nature, that the focus

becomes solely on the detail of the various sub-indicators and the larger picture is lost. Annex 2 provides a set of tables intended to give an initial indication of the type of reporting level information that could be generated using the measurement approach described in this paper. The stylized tables in the annex have been prepared assuming that there are three countries (A, B and C) and 10 sub-indicators across the economic, environmental and social dimensions. The data are purely indicative and not reflective of any specific country.

4. Determining the scale, scope and sustainability dimensions

Scale of sustainability assessment

In terms of scale, the ultimate ambition for SDG measurement is to provide an indicator that gives a national result but which also can be disaggregated to provide information of direct relevance for policy development, response and monitoring which will generally be at sub-national scales. In this context, an important question is the spatial level at which the balance between the dimensions of sustainability should be assessed.

The conclusion reached in for indicator 2.4.1 is on the derivation of a country level indicator based on farm level information. The development of a national level indicator for SDG reporting purposes is then, in principle, a matter of aggregation. The choice to use a farm level scale for assessing sustainability aligns best to a more internal perspective on sustainability as discussed in the previous section.

Measurement scope

The scope of agricultural activities

The measurement scope of the indicator concerns the types of farms and the types of agricultural production that are to be included in the indicator. Of the five agricultural sectors, it has been agreed that for the purposes of indicator 2.4.1 the focus should be on agricultural land, and therefore mainly on crops and livestock. Thus, the sectors of forestry, aquaculture and fisheries are excluded (details given below). It is noted that the measurement of sustainable fisheries and sustainable forestry will be captured in some way through measurement of SDG 14 and 15.

This choice of scope is most consistent with the intended use of a country's *agricultural area* as the denominator of the aggregate indicator. Agricultural area is defined as arable land plus permanent crops plus permanent meadows and pastures (FAO, Land use and irrigation codes, 2014). The assessment of sustainable agriculture is thus constrained to assessing the production of crops and livestock that takes place within a country's defined agricultural area.

While this provides an initial framing for analytical purposes it is not sufficient for statistical purposes. The following points explain the proposed treatment in relation specific measurement boundary issues. The explanation of these boundary issues is important in being able to appropriately interpret the results.

- Agro-forestry (trees on the farm) systems are within scope.
- On-farm aquaculture, including rice-fish and similar systems should be included. Aquaculture will generally be excluded but to the extent that some aquaculture is considered to take place within the agricultural area then some fish production would be in scope.

- Food harvested from the wild. In some countries and for some population groups this might be an important source of nutrition. However, since it is likely that these food sources will be sourced from outside of agricultural areas then the sustainability of such activity will not be within scope of the indicator.
- Subsistence agriculture. This should be included in the indicator. It is likely that a range of production of crops and livestock within agricultural areas will be subsistence in nature – i.e., the production is consumed by the producer's household. A key challenge for measurement will be estimation of the volume and value of production. It is noted that this production is often conceptually within scope of agricultural surveys and also within scope of standard production measures of the national accounts, but in practice the collection of data and estimation of production may be difficult.
- Non-food crops and livestock. Crops such as tobacco, cotton, and livestock raised for non-food products (e.g. sheep for wool), may be significant in some countries and under the proposed scope would be included in the assessment of sustainable agriculture.
- Crops grown for fodder or for energy purposes are included. Many crops that may be grown for food may also be grown for non-food purposes – maize is perhaps the best example. A related question is the appropriate treatment of fodder crops grown to support livestock production – the production of both fodder and livestock is within scope of the indicator at present even though one is an input to the other. Thus, all crops, grown for whatever purpose, are included in the indicator.
- Intensive production. On the whole, the framing of the indicator considers production processes that are more extensive in nature such that production can be clearly related to the area of land under cultivation or grazing. Production of crops and livestock using intensive means including in feedlots, greenhouses, etc. changes the nature of the relationship between production and land area. In some case, intensive but small scale farming systems have been practiced traditionally but the issue here relates to large scale intensive production of, for example, beef and chicken. Both intensive and extensive production of agricultural outputs is included in the indicator.
- Common lands. These are lands that are jointly used by farmers, particularly for livestock. The agricultural products from these lands and the associated agricultural areas are within the scope of the indicator although attribution of some information to generate farm level indicators may be challenging.
- Production from gardens and backyards. This production, which is conceptually within scope of aggregate food production, will be excluded from the indicator as this production is not considered to take place within agricultural areas.
- Production from hobby and similar farms. Production from these farms will be in scope of the indicator since these farms will generally be included in scope of a country's agricultural area.

Some of these issues are likely to be at the margins in terms of assessing overall sustainability in agriculture. Others may well be significant in some circumstances. Careful consideration of the desired treatment is required to ensure that the measurement is appropriately targeted and that interpretation of the indicator is well understood.

Overall, the challenge posed in the measurement of this indicator is coping with the sheer diversity of agricultural outputs. It may be considered that, on the whole, the issues raised above do not

substantially affect the likely messages to emerge from the aggregate indicator. This may be true. However, since the intention is to construct the indicator from farm level, the characteristics of the farm will be of direct relevance in the assessment of sustainability and the diversity of farming situations may mean that subsequent aggregation is more difficult.

Other scoping issues

Beyond defining the measurement boundary for agricultural production the following considerations are noted.

First, the scope of assessment does not extend to the sustainability of the transportation, storage, processing, distribution and marketing of agricultural products – the agricultural value-chain - although it is accepted that the efficiency and effectiveness of the delivery of these services may be significant in assuring the provision of food. Of particular relevance here is the issue of food waste, which, for varying reasons depending on the country, is likely a very significant issue in the assessment of sustainable provision of food. SDG 12 addresses the issue of sustainable consumption and production and specific indicators exist to capture sustainability in the value chain.

Second, the proposed approach does not take into consideration directly the sustainability of supply chains that provide inputs to agricultural production. For example, the general concerns about the availability of phosphorous as a key element in fertilizers, will not be captured except to the extent that reductions in its availability increase the price of fertilizers and hence reduce profitability at farm level. Note though that, in this specific case, the decline in soil health at farm level due to nutrient imbalance will be within scope of the sub-indicators.

Third, the scoping of agriculture for the dashboard and aggregate indicator does not take into account impacts of agricultural production systems on human health in terms of food security or dietary outcomes, or in terms of the downstream impacts of particular agricultural practices (e.g. the use of certain pesticides or antibiotics in livestock raising). It is considered that the changes in human health and other social outcomes should be considered at a broader scale than farm level and should be captured in other SDG indicators.

Determining dimensions

In terms of process it is important to distinguish between the selection of dimensions (e.g. economic), themes (e.g. profitability) and the sub-indicators that are used to reflect them in the overall measure or indicator set (e.g.net farm income). Given the lack of a single conceptual framing for measurement, the process of selecting dimensions and themes is essentially one of individual rationalization or participatory approaches building on relevant experience, literature and discussion. Since the outcomes of these approaches are not likely to generate the same conclusions (i.e. different groups of experts will reach different conclusions), even in cases where the focus of measurement is the same, there are no standard or universally accepted sets of dimensions and themes for the measurement of sustainable agriculture.

At the same time, there are some dimensions that are more readily identified in the literature. The clear trend in measurement of sustainability is for coverage of all primary dimensions, i.e. economic, environmental and social.

In recent years, other broad aspects associated with sustainability have been considered as additional dimensions, notably resilience and governance. For this indicator, governance is considered to be a

means by which sustainability is secured and is not considered part of the assessment of sustainability itself.

The concept of resilience is considered important and aspects of resilience will be captured through measurement of the changing quality and condition of economic, environmental and social capitals that underpin the delivery of sustainable outcomes.

5. Sustainable agriculture dashboard for SDG 2.4.1

As described in section 3, the first part of the measurement approach for SDG 2.4.1 is the compilation of a dashboard of relevant sub-indicators across the three dimensions of sustainable agriculture. This dashboard will provide a clear framework for the regular monitoring of progress towards sustainable agriculture. In particular the selection of sub-indicators is designed to encourage measurement in all three dimensions and hence ensure a broad discussion of sustainability.

Regular monitoring of the set of sub-indicators described here will likely require development of additional data sources. However, as far as possible, the selection has been informed by the understanding of the data that are commonly available or expected to be developed, and from an understanding of the intentions for reporting against other SDG indicators.

The remainder of this section describes the two key steps in establishing the SDG 2.4.1. dashboard, i.e. the selection of themes and the choice of sub-indicators.

Selecting themes

In selecting themes, the outcomes can be quite diverse depending on the number of themes considered appropriate to encapsulate the concept of sustainable agriculture being considered. In a number of examples of sustainable agriculture measurement, more than 30 themes are proposed. In devising SDG 2.4.1, it was decided to identify 9 themes, evenly distributed across the three dimensions of sustainability. This choice was dictated by the need to find an acceptable balance between the need to capture the main features associated with sustainability, and at the same time keeping indicator measurement feasible and affordable.

The literature review identified a broad range of potential themes for inclusion and for each theme usually a number of different sub-indicators can be considered. The key consideration in the selection of themes is the strength of the connection between movements in the associated sub-indicator and outcomes for sustainable agriculture at farm level. This connection is important such that the dashboard can be considered to comprise sub-indicators that will be responsive to farm level policies that are targeting improvements in sustainable agriculture. The connection is also an important factor in being able to establish the aggregate indicator since this requires a clear connection between each sub-indicator and the overall assessment of farm level sustainability.

Another important consideration in this discussion is measurability. In this regard the approach was to identify a limited set of “core” themes for which measurement and reporting is expected in all countries and a broader set of themes for which measurement might be undertaken by countries for national polices purposes (a broader list is provided in annex 3).

There is a clear need for the themes to provide a balance across economic, environmental and social themes with the intent of demonstrating that each dimension is equally relevant in an overall discussion and assessment. Undoubtedly, discussion of each dimension might be informed by

information on additional themes or examining data at greater levels of disaggregation, for example by type of production system.

Two points deserve mention. First, at a national level, countries may consider including additional themes to provide a greater coverage but, in the interest of providing a common base for assessment, there is a strong recommendation that a core set of themes are measured on a regular basis.

Second, the selection of themes for this indicator must be seen in the context of other SDG indicators that cover the full range of economic, environmental and social themes. This is especially important when recalling that, for SDG 2.4.1, the intention is to focus on a farm level assessment of sustainable agriculture rather than provide information to support a more generalized discussion on the contribution of agricultural activity to various economic, environmental and social outcomes.

Choosing sub-indicators

General observations

Choosing sub-indicators is a distinct step in the process. For any given theme there may be multiple sub-indicators that are relevant and/or possible. Consequently, it is common for those establishing a set of sub-indicators to define requirements for sub-indicator selection and, while differently worded, there are some generally agreed principles that are utilized. The five key principles to be considered in choosing sub-indicators for indicator 2.4.1 are:

- Policy relevance
- Universality
- Comparability
- Measurability
- Cost effectiveness

Sub-indicators may be of three broad types. They may be:

- Impact/outcome indicators that record what the state or change in state of environmental, economic and social factors and associated flows of benefits or costs.
- Practice indicators that record the type of agricultural practices and processes that a farm is undertaking
- Perception indicators that record views of various stakeholders about different aspects of sustainability.

For the purposes of SDG reporting and consistent application across countries, it is considered that impact/outcome indicators should be the focus of measurement, noting that practice indicators 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. Practices 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. All earlier attempts to establish a list of sustainable practices for application at global level have failed to identify universally agreed practices. Perception indicators are not considered to be amenable to broad scale measurement and aggregation, and offer a level of subjectivity hardly acceptable in the computation of an indicator like SDG 2.4.1.

Proposed themes and sub-indicators

The proposed sub-indicators are listed in Table 1 below for each theme. In total there are 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 methodological sheets provided as supporting documents. The methodological sheets provide descriptions of the relevance, definition, data and measurement issues, and considerations with respect to sustainability assessment criteria for each sub-indicator.

Table 1: Proposed themes and sub-indicators

Dimension	No.	Theme	Sub-indicators
Economic	1	Land productivity	Farm output value per farm agricultural area
	2	Farm profitability	Net farm income
	3	Financial resilience	Access to financial services
Environmental	4	Soil health	Soil health
	5	Water health	Water use
			Water quality
	6	Biodiversity	Heterogeneity of agricultural landscapes
Social	7	Decent work	Wage rate in agriculture
	8	Well-being	Agricultural household income
	9	Access to land	Secure rights to land tenure

Data collection and reporting

As discussed above, the intention is to measure all of the relevant sub-indicators at farm level. Ideally, all of the required information would 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.

An alternative approach to building the indicator 2.4.1 using non-farm level assessment i.e. national level assessment based on existing data sources is also considered for testing in selected countries. The aggregation of indicator 2.4.1 using this approach is described in annex 4.

6. Deriving the sustainable agriculture aggregate indicator for SDG 2.4.1

Introduction

As described in section 3, the aim of the measurement approach for SDG 2.4.1 is the derivation of an aggregate indicator. The various approaches and considerations in the development of aggregate indicators are described in the literature review (Hayati, 2017). The motivation for the development of an aggregate indicator for SDG 2.4.1 is twofold. First, there are clear advantages in conveying the messages about sustainability through a single measure. These advantages include the clarity of message, the potential to understand contributions to overall change and the resonance across multiple audiences. These advantages do come with risks including the potential for the indicator to mislead or overlook information. Consequently, a single aggregate indicator must be (i) based on a clear approach to aggregation; and (ii) as comprehensive as possible in its inclusion of information about the target concept.

Second, notwithstanding the known concerns on measurability and interpretation, there is clear interest in the statistics community in the development of aggregate measures of sustainability that

satisfy these two requirements. This interest was demonstrated in the acceptance by the IAEG-SDG in March 2016 of the general formula and broad approach described for the aggregate indicator of sustainable agriculture (see Annex 1).

It is acknowledged that the aggregate indicator endorsed for SDG 2.4.1 is the only indicator of sustainability across the suite of SDG indicators that encompasses the three dimensions of sustainability. Further, it is acknowledged there is no widely endorsed conceptual framework that would support the full integration of economic, environmental and social dimensions.

Farm level methodology

Methodologically, without an integrated conceptual framework for measuring sustainability, and since the option of a composite index has been excluded, there remains only one general approach to the construction of an aggregate indicator. This involves (i) the selection of a limited set of sub-indicators relevant to sustainable agriculture at farm level (as completed above); (ii) assessing the sustainability performance of a farm against each sub-indicator; and (iii) on the basis of these individual sub-indicator based assessments drawing an overall conclusion with respect to sustainability. The broad method proposed to the IAEG-SDG in March 2016 follows this approach of deriving a sustainability performance based aggregate indicator.

In deriving the aggregate indicator, the proposed approach is to estimate the indicator at farm level and then aggregate to sub-national and national level. Based on the proposed sub-indicators, this is a two-step process requiring:

1. Assessing the sustainability performance of an individual farm (agricultural holding) against each sub-indicator.
2. Determining overall sustainability.

Assessing sustainability performance for each sub-indicator

Technically, the most challenging part of this method is determining the criteria to be used for the assessment of sustainability performance. The approach to be adopted is that, for each sub-indicator, appropriate criteria to assess sustainability are developed based on the conceptual considerations provided in Section 7. Then, depending on the context, a specific criteria value is determined 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.

In deriving SDG 2.4.1, it has been considered that it would be easier to find an agreement on what is not sustainable rather than to try defining what is sustainable. The concept of sustainability implies an idea of continuous progress and improvement along its three dimensions towards better performances across all sub-indicators, and such performances can therefore be more or less sustainable. There are, however, lower limits in the performances, below which it is easier to agree that sustainability is not achieved. The methodology to derive SDG 2.4.1 is predicated on the acceptance that such a limit can be used as sustainability criteria for each sub-indicator.

By way of example, for a sub-indicator of net farm income, the anticipated criteria value would be zero. Thus, if the observed values of net farm income are consistently greater than zero then the farm would be assessed as sustainable against that sub-indicator. In yet other contexts, such as concerning access to land and finance, the observed values will indicate degrees of access perhaps in terms of distinct classes or categories. In this case the criteria value will need to reflect a chosen class or category of access rather than a numerical value.

Proposals for sustainability assessment criteria are provided in the respective methodology data sheets for each sub-indicator. Following the general method for establishing the sustainability criteria listed in Table 2, it is expected that each country will assess the sustainability of their agriculture in an internationally comparable way. Due to variations in a country's economic, social and environmental conditions, for some sub-indicators, the sustainability criteria are based on country specificities e.g. relative efficiency for productivity. For other sub-indicators, the criteria are generic and not country specific e.g. zero and above for net farm income and zero groundwater depletion for water use, etc.

Table 2: Proposed criteria for sustainability assessments

Dimension	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

Table 3 demonstrates a basic template for recording the results from farm level assessments. The columns represent the information for each agricultural holding, and the rows show the variables. The basic variables are: Agricultural holding identity number, the size of the agricultural holding, the sample weight, categorical variables related to sustainability for the themes listed for the study and finally rows to record the overall sustainability result.

For each agricultural holding an entry is needed for each sub-indicator based on the sustainability assessment – i.e. the comparison of the observed sub-indicator value against the criteria value. The entries will be 1- Yes/Sustainable; 2- No/Not sustainable; or 3 – Not applicable.

Table 3: Table for recording sustainability assessments for Agricultural holdings by sub-indicator

Variables	Agricultural Holding					
	1	2	3	4	5	…
Agricultural holding ID						
Size of Agricultural holding (ha)						
Agricultural area (ha)						
Weight in farm survey sample						

Themes scores (1; 2; 3)	Sub-Indicators						
1- Land productivity	Farm output value per farm agricultural area						
2- Farm profitability	Net farm income						
3- Financial resilience	Access to financial services						
4- Soil health	Soil health						
5- Water health[1]	Water use						
	Water quality						
6- Biodiversity	Heterogeneity of agricultural landscape						
7- Decent work	Wage rate in agriculture						
8- Well-being	Agricultural household income						
9- Access to land	Secure rights to land tenure						
Overall assessment							
Economic dimension							
Environmental dimension							
Social dimension							
Farm sustainability status							
Area of productive and sustainable agriculture (ha)							

Once the table has been populated with data, it is possible to determine whether a given agricultural holding is sustainable overall based on the aggregation approaches described below.

Constructing an aggregate indicator for a region or country

The final step in the sustainability assessment process at farm level is the aggregation across sub-indicators to give an overall assessment. Since the selected themes will have no natural or inherent relative weight or importance, all must be assumed to be equally relevant in the aggregate assessment. Nonetheless, aggregation rules are still required to provide an overall assessment. In essence, it is necessary to establish a proportion of sub-indicators that are sustainable.

If all farms within a country are able to be assessed (i.e. a census of agricultural holdings), then an aggregate indicator is formed by summing the area of farms considered sustainable. If a sample of farms is used, then, each agricultural holding assessed as sustainable should be multiplied by its relative sample weight to provide an estimate of the total productive and sustainable agricultural area.

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

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

where AA refers to agricultural area.

Two approaches to determine overall sustainability of a farm are considered. The first is that the area of farms (agricultural holdings) considered productive and sustainable when all 9 themes (and 10 sub-indicators) are assessed as having sustainable performance relative to its criteria. This is known as a "One Out, All Out" approach.

[1] For the Water Health theme to be considered sustainable the criteria of sustainability for the both of the two water sub-indicators should be satisfied.

The second approach is to consider each dimension – economic, environmental, and social in turn. For each dimension, a 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. This is known as the dimension based approach.

a. One Out All Out (OOAO) approach:

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

$AA = Total\ agricultural\ Area$

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

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

$AA_{env-sust} = Agricultural\ area\ envorionmentally\ sustainable$

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:

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

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

b. Dimension Based Approach (DBA):

Under this approach it remains necessary for a farm to be considered sustainable in each dimension, and hence the overall sustainability is still reflected in the notation used above i.e.:

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

However, under this approach it is not necessary for all themes in each dimension to satisfy the sustainability criteria but rather any two of the three. In this case, in order to operationalize the estimation, the same formula as above can be used but with a variation in the definition of S_i. Thus:

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

Where:

AA_i = Agricultural area of Farm i

S_i' = General assessment of sustainability of farm i

S_i' = 0 when at least two themes in at least one dimension are considered not sustainable

S_i' = 1 when 2 out 3 themes in each dimension are considered sustainable or not applicable

Other considerations

In forming the aggregate measures and ensuring complete coverage, an important aspect will be determining the total agricultural area of a country since this provides both the denominator and the conceptual scope for the sustainability assessment. Two practical points that will need to be considered here are:

- determining the extent to which the coverage and design of the farm survey encompasses the entire agricultural area.
- determining the extent to which the total area of land under the management of farmers (the farm holding) is different from the associated agricultural areas. Differences will emerge due to, for example, conservation areas on farm holdings.

For the purpose of calculating the aggregate indicator, the statistical unit is necessarily the agricultural holding that is measured using agricultural area. Thus the assessment of sustainability refers to the agricultural holding as a whole (i.e. farm level) and the evaluation of the sub-indicator should label the agricultural holdings included in the survey as the primary source for computing the indicator. Similarly, evaluation of sustainability is done at the level of the agricultural holding.

Particular consideration may be given to commonly owned land. Normally, the total agricultural area includes common land. However, common land is not associated to a specific farm. One possible solution would be to exclude the area of common land from the denominator of the aggregate indicator. However, the phenomena is relevant in many countries in which a significant number of farmers, with or without land, rely on livestock farming using free common grassland.

If the use of common land is considered a kind of non-secure means of access to land[2], it must be included in the denominator (total agricultural land) and removed from the numerator (sustainable area). On the other hand, if the use of common land is considered a kind of secure means of access to land albeit as part of a collective approach to land tenure, then ideally a fraction of the common land should be allocated proportionally to the farms that declare the use of common land based on the quantity of livestock units belong to each farm.

Also related to the farm survey design, it will be necessary to understand whether cut-offs are used in establishing the frame for the collection. For example, some farm surveys limit their coverage to farms with a value of operations above a certain monetary threshold. This would tend to exclude smaller and subsistence farms whose contribution to total agricultural area and overall sustainability may be very important in some countries. Overall, have a clear understanding of the coverage of farm surveys will be an important aspect in ensuring the meaningfulness of the aggregate results.

7. Next steps

This methodological document provides a description of the proposed approach to the construction of an aggregate indicator to monitor sustainable agriculture as defined under SDG 2.4.1. It builds on the general framing for this indicator endorsed by the IAEG-SDG in December 2015 and benefits from a range of contributions since then, including the Expert Group Meeting of April 2017 and initial results from country level testing.

The development of the methodology is stepwise. An extensive literature review documented how sustainable agriculture has been defined in the past. This information was then used during an international consultation with country statisticians and technicians, which culminated in expert meetings in December 2016 and April 2017.

A pilot phase is underway in five countries, with National Statistical Offices leading the work. As a first step, countries are documenting what information is already being collected, primarily through farm surveys and remote sensing. They are then using this information to build the indicator. Based on the findings from the country level testing, the proposals on the sub-indicators and the methods of aggregation and sustainability assessment will be refined.

The next steps include:

- Training for countries participating in the pilot study.
- Designing a module/vehicle that collects all information related to the indicator and testing it in the pilot countries.
- Rolling out the questionnaire region by region.
- Capacity development in countries for the collection, aggregation and dissemination of the indictor.

In the future, this information can be regularly collected from National Statistical Offices and disseminated through FAO's FAOSTAT.

[2] In fact, common land can hardly be considered sustainable in terms of "secure right to land".

Annex 1: Sustainable Development Indicator Target 2.4: Methodological Note

Approved by IAEG-SDG, March 2016

Target 2.4	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
Indicator 2.4.1	**Proportion of agricultural area under productive and sustainable agriculture**
Definition and method of computation	The indicator is defined by the following formula: $$Percent\ of\ land\ under\ productive\ and\ sustainable\ agriculture = \frac{Area\ under\ productive\ and\ sustainable\ agriculture}{Agricultural\ area}$$ Where $$Agricultural\ area = arable\ land + permanent\ crops + permanent\ meadows\ and\ pastures$$ The **denominator**, agricultural area, is a well-known and established indicator that are collected by statistical bodies in countries and compiled internationally via a questionnaire by FAO. These data are available in FAO's database FAOSTAT. The **numerator** captures the three dimensions of sustainable production: environmental, economic and social. The measurement instrument – farm surveys – will give countries the flexibility to identify issues related to sustainability that are most relevant to priorities/challenges within these three dimensions. Land under productive and sustainable agriculture will be those farms that satisfy indicators selected across all three dimensions.
Rationale and interpretation	There has been considerable discussion over the past thirty years on how to define "sustainable agriculture." Sustainability was often understood mainly in its environmental dimension. Yet, it is well established that sustainability needs to be considered in terms of its social, environmental and economic dimensions. The indicator has been operationalized in order to capture its multidimensional nature. Challenges to sustainable agriculture vary within and across countries, and by region and are affected by socio-economic and bio-physical conditions. By addressing sustainability across its three dimensions, countries can select those metrics within their measurement instrument that best capture the priorities most relevant to them. A further metric will be added to capture the resilience dimension of the target. A set of possible metrics for each dimension will be established in order to ensure relevance across the whole range of possible socio-economic and bio-physical conditions. Farm surveys will be designed on the basis of a limited set of these measurements, established at national level in order to cover the most relevant aspects of these dimensions of sustainability. Each surveyed farm will be assessed against targets for each of these measurements, decided at national level. The area of farm that satisfy the targets in all dimensions would be considered as sustainable; otherwise no. Progress would be measured against a benchmark, which would show trends over time.
Data sources	Data on sustainable production will most likely be collected through agricultural surveys or agricultural modules in integrated household surveys organized by the national statistical agencies, with support from FAO or other international agencies to ensure methodological rigor and harmonization. It is expected that these measurements will be integrated and complemented by earth observation technologies, either by or under the overall supervision of national statistical agencies.
Disaggregation	As long as farm or household level data are available, the indicator can be computed for specific population groups and geographical areas. The level of disaggregation depends on

Target 2.4	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
Indicator 2.4.1	**Proportion of agricultural area under productive and sustainable agriculture**
	the sample design and sample size in each specific country, but, in general, data can be tabulated by geographical area, size of the farm, gender and age of the enterprise manager.
Comments and limitations	Data from farm surveys can be supplemented with information from other sources, including geospatial data/remote sensing or other techniques to capture environmental data. Data collection or data sharing may be difficult in some countries.
Data for global and regional monitoring	Data for global and regional monitoring will be obtained from aggregation of national data. They can be complemented or enhanced by the use of well selected earth observation data.
Supplementary information	The methodological development of the indicator could benefit from the support from the Global Strategy to improve agricultural and rural statistics, a program aiming at improving countries' capacities to produce agricultural and rural statistics in support to more effective food security and agricultural and rural development policies. As part of this program, FAO, in collaboration with IFAD and the World Bank, are working towards the establishment of a harmonized and cost-effective program of Agricultural and Rural Integrated Surveys (AGRIS) that could form the basis for the collection of data on indicator 2.4. Through this program, methodological guidelines on how to conduct enterprise surveys in agriculture will be developed and provided to countries, together with technical support in the implementation of the farm surveys. ___ The proposed indicator for 2.4 is directly linked – and may either draw from or provide information to – other proposed SDG targets: • 2.3 (agricultural productivity). The link between SDG 2.3 and 2.4 is especially strong. Data for these two indicators can be jointly collected through the same integrated survey. • 6.3 (Improving water quality) • 6.4 (water use efficiency) • 12.2 (efficient use of natural resources) • 15.2 (sustainable management of forests) • 15.3 (land degradation)
References	- http://faostat3.fao.org/download/R/RL/E - http://www.fao.org/sustainability/en/ - Building a Common Vision for Sustainable Food and Agriculture - http://www.fao.org/3/a-i3940e.pdf

Annex 2: Stylized reporting tables and potential presentations

The following five tables, introduced in Section 3, are intended to provide a general impression of the type of reporting that would be possible using the criteria based aggregate indicator approach described in this paper. The figures are illustrative only.

Tables 1 – 4 provide summary tables based on the organization of more detailed underlying data as presented in Table 5. The stylized example assesses sustainable agriculture in three countries (Countries A, B and C) across the three dimensions of sustainability – economic, environmental and social. Ten sub-indicators have been utilized as listed in the headings of Table 5. Three cover the economic dimension, five cover the environmental dimension and two cover the social dimension.

In the example, these 10 sub-indicators have been used to assess a range of farms in each country. The farms have been classified by three types of output (crops, livestock, mixed) and also by five size classes (subsistence, small, medium, large, very large). By collecting and classifying the information in these ways, a wide range of output combinations can be presented. Indeed, the examples of summary presentations shown in Tables 1-4 should be seen as indicative and many other combinations could be developed based on the same underlying dataset.

When testing the development of this indicator, it is envisaged that countries will work towards collecting data that allows for the assessment of sustainability for different farms based on their type of output and size. By using a common set of sub-indicators it will be possible to make useful comparisons across different types of farms with respect to sustainability and hence support policy development and analysis.

Table 1 - World percentage of productive and sustainable agricultural area by sustainable dimension

Dimensions of sustainability	World agricultural area	
	Thousent ha	%
Total	4 889 048	100.0
Productive & sustainable	332 728	6.8
Economic sustainable	869 037	17.8
Environmentaly sustainable	835 100	17.1
Socialy sustainable	1 874 940	38.3

Table 2 - Percentage of productive and sustainable agricultural area total and by dimension by country

%

Country	Productive and sustainable	Dimensions		
		Economic	Environmental	Social
World	**6.8**	**17.8**	**17.1**	**38.3**
Country A	3.7	16.8	11.0	35.8
Country B	8.7	18.6	20.6	40.0
Country C	10.3	17.7	25.2	41.0

Table 3 - Sustainability of agricultural area by countries

Sustainability	World agricultural area		Country		
	Thousent ha	%	A	B	C
Total	**4 889 048**	**100.0**	**100.0**	**100.0**	**100.0**
Productive and sustainable agriculture	332 728	6.8	3.7	8.7	10.3
Non sustainable agriculture	4 556 320	93.2	96.3	91.1	89.7
Non sustainable due to:					
1 sub-indicator	151 512	3.1	1.8	3.8	5.0
2 sub-indicators	766 251	15.7	17.0	14.7	14.5
3 sub-indicators	898 149	18.4	22.7	16.8	8.4
4 sub-indicators	1099 977	22.5	22.1	23.1	21.3
5 sub-indicators	716 334	14.7	10.8	16.7	20.3
6 sub-indicators	539 493	11.0	14.1	8.0	12.2
7 sub-indicators	384 304	7.9	7.7	8.0	8.0

Table 4- Percentage sustainable agricultural area accoding sustainable dimension by type of activity

%

Type of activity	Productive and sustainable	Dimensions		
		Economic	Environmental	Social
World	6.8	17.8	17.1	38.3
Livestock	3.4	3.5	21.2	37.8
Crops	2.9	20.7	10.6	37.7
Mixed	24.9	41.4	25.7	41.3

Table 5 - Percentage sustainable agricultural area according sub-indicators and countries

%

Country	Productive and sustainable	Economic			Environmental					Social	
		Productivity		Profitability	Soil		Water	Biodiversity	Energy	Decent work	Household income
		Labour productivity	Land productivity	Farm profitability	Erosion	Carbon soil	Water polution	Conservation	Energy efficiency	Working poor	Poverty
World	6,8	72,8	43,8	58,6	63,4	60,2	53,5	67,7	80,0	39,6	85,7
Country A	3,7	87,2	28,0	67,1	52,0	53,3	48,6	74,9	71,4	36,0	96,6
Country B	8,7	66,0	51,6	54,7	69,9	63,4	56,4	64,4	85,5	41,8	81,1
Country C	10,3	46,8	70,7	42,9	79,5	73,0	60,2	54,1	89,4	44,2	64,2

Table 6 - Percentage sustainable agricultural area according sub-indicators by farm size

%

Country	Productive and sustainable	Economic			Environmental					Social	
		Productivity		Profitability	Soil		Water	Biodiversity	Energy	Decent work	Household income
		Labour productivity	Land productivity	Farm profitability	Erosion	Carbon soil	Water polution	Conservation	Energy efficiency	Working poor	Poverty
World	**6,8**	**72,8**	**43,8**	**58,6**	**63,4**	**60,2**	**53,5**	**67,7**	**80,0**	**39,6**	**85,7**
Subsistance	1,8	2,9	100,0	3,7	100,0	100,0	68,1	22,6	98,8	11,4	3,0
Small farms	14,3	49,5	79,7	14,3	99,3	99,3	65,1	37,5	89,0	33,4	24,5
Medium farms	11,2	40,6	70,6	60,2	69,5	58,6	61,0	62,4	89,1	60,3	89,9
Large farms	2,5	100,0	23,7	68,2	61,9	50,6	47,8	81,0	72,9	28,2	100,0
Very large farms	2,3	100,0	12,5	70,7	41,8	50,9	44,3	78,2	70,9	29,6	100,0

Table 7 - Percentage sustainable agricultural area according sub-indicators by type of activity

%

Country	Productive and sustainable	Economic			Environmental					Social	
		Productivity		Profitability	Soil		Water	Biodiversity	Energy	Decent work	Household income
		Labour productivity	Land productivity	Farm profitability	Erosion	Carbon soil	Water polution	Conservation	Energy efficiency	Working poor	Poverty
World	**6,8**	**72,8**	**43,8**	**58,6**	**63,4**	**60,2**	**53,5**	**67,7**	**80,0**	**39,6**	**85,7**
Livestock	3,4	84,7	21,6	51,9	50,8	66,2	73,7	79,0	95,2	38,1	93,9
Crops	2,9	62,5	52,1	62,0	74,7	49,0	41,2	55,8	72,1	37,7	87,0
Mixed	24,9	74,2	70,5	64,3	60,9	77,3	42,2	75,1	67,8	48,1	64,3

Annex 3: Long list of themes considered in developing an indicator on sustainable agriculture

Dimensions	Themes	Sub-indicators
Economic	Land productivity	Farm output value per farm agricultural area
	Farm profitability	Net farm income
	Financial resilience	Access financial services
		Debt to Asset Ratio
	Labour productivity	Farm output value per hours worked
Environment	Soil health	Soil health
		Rates of soil erosion
		Soil organic carbon
	Water Health	Water use (Groundwater over-exploitation)
		Water use efficiency (value/m3 of water used in irrigation)
		Water quality (Pollution from Nitrogen)
		Pollution from fertilizers
		Pollution from pesticides
	Biodiversity	Heterogeneity of agricultural landscape
		On-farm domestic biodiversity
	Land-use change	Agricultural expansion on fragile ecosystems
	Energy use	Energy use intensity (energy used/value of production)
	GHG emissions	GHG emission intensity (GHG emission/value of production)
	Burning	Percentage of farms where burning is practiced
Social	Well-being	Agricultural household income
		Rural poverty headcount ratio
	Access to land	Secure rights to land tenure
	Decent work	Wage rate in agriculture
		Extent of forced and child labour
	Household/farm resilience	Farm income diversification
	Access to Knowledge	Education level achieved
		Participation in collective groups
	Gender equality	Participation of women in household decision making
	Occupational health and safety	Incidence of workplace injuries and deaths

Annex 4: Alternative approaches for constructing indicator 2.4.1

National level assessment:

The assessment and aggregation method described before assumes that the data are available to assess sustainability for all themes and the corresponding sub-indicators at a farm level (directly or through imputation). Where this is not possible, but where data are available for some sub-indicators at a more aggregate spatial level, e.g. national or sub-national level, alternative approaches to estimating the area of productive and sustainable agriculture should be tested.

Different approaches may be considered to assess sustainability for an individual sub-indicator using non-farm level data, depending on the sub-indicator and the type of source data. The key issue is the need to reach a conclusion that pertains to agricultural area. These approaches should be considered open to development and improvement through the testing process. The main challenge in applying the indicator approach at national level is converting the comparison between the measured sub-indicator and its threshold into a measure of area. The generic approach is to determine the proportion of farms/agricultural holdings that satisfy the criteria for a given sub-indicator and multiply this by the total agricultural area. This will provide an estimate of the agricultural area that is sustainable for that sub-indicator. Once an estimate of the agriculture area considered productive and sustainable has been developed for each theme, it is necessary to perform the aggregation. This may be undertaken in two ways:

a. Maximum productive and sustainable area

Considering a case where there are three themes across the three dimensions, it may be that 70 percent of the agricultural area is sustainable with respect to farm profitability, 50 percent for well-being and only 30 percent for soil health.

One approach to determining the aggregate result is to conclude that it is the maximum area that is sustainable – i.e. 30 %.

Using the notation introduced above, SDG 2.4.1 would be represented as:

$$SDG\ 2.4.1max = \frac{Min\ (AA_{sub1},\ AA_{sub2}\ , \dots, AA_{subn})}{AA}$$

While measured as a minimum, this approach actually provides an upper bound since while no more than 30 percent of the agricultural area can be sustainable, if assessed from a farm level, there may be farms that are sustainable with respect to soil health but not with respect to either farm profitability or well-being.

b. Average of productive and sustainable areas

A second approach for aggregation is to use the average of the sustainable areas across the themes. That is:

$$SDG\ 2.4.1average = \frac{AA_{sub1}\ +\ AA_{sub2} \dots +\ AA_{subn}}{AA * n}$$

Using the simple example given above, the resulting value would be that 50 percent of the agricultural area would be considered sustainable. This approach is not preferred, but it would be useful to test the sensitivity of the aggregate results to the use of this approach.

Additional considerations for the national level assessment:

In this approach, it is not necessary to have the agricultural holding as a generic unit of observation for any sub-indicator. For each sub-indicator, just the total agricultural area considered sustainable needs to be estimated. For this purpose, different data sources can be used:

- Agricultural censuses and surveys
- Commodity specific production and price data
- Specialized surveys
- Labour force surveys
- Household surveys
- Community surveys
- Environmental monitoring systems
- Remote sensing, including satellite and other geo-spatial data sources and modeling
- Administrative data (e.g. taxation or land related datasets)
- Cadastral data and land revenue records
- Others

The mix of data sources will depend on the precise scope and design of different collections, and the availability of survey and administrative data. As far as possible existing data collection approaches should be used, combined and enhanced to provide the required information. Some examples are given below:

- Household survey is the main source of information for social aspects. Household surveys provide information about household income and could have other required data. However, the household records need to be attached to an agricultural holding in order to associate the information to agriculture area (e.g. LSMS-ISA can provide data for productivity, profitability, land tenure and household income).
- Another source that might be used is geospatial and remote sensing data, including satellite imagery. This may be useful for measuring environmental indicators, like land cover information to assess biodiversity. Other data that are likely to be spatially specific will be information on water resources including ground water, which may commonly be available with respect to water catchments. Combination of remote sensing estimation of agricultural area and data from monitoring system could provide required information about water use and quality.
- Cadastral normally have the information about the extent, use, value, ownership and tenure of land and could provide information related to the right to land sub-indicator under social dimension.
- Price and cost of production data from other sources can be adjusted and used in combination with farm surveys focused on production to support estimation of sub-indicators related to economic dimension

While collection and compilation of individual sub-indicators may be inconsistent, it is recommended that sustainable agricultural area be reported for the reference year with appropriate assumptions and adjustments made concerning the estimates of those sub-indicators for which data have not been collected in a reference year.

Data collection and reporting

A particular challenge is that the data available for different component variables and hence different sub-indicators may relate to different time periods. Ideally, data for all variables and sub-indicators would be assessed in relation to the same time period.

In terms of initial implementation, an important consideration will be the need to provide a baseline or benchmark estimate of sustainability, and for this purpose, data for all sub-indicators should be estimated for a reference year. But since trends in some sub-indicators may change relatively slowly over time, reporting every 3 years may be more appropriate and provide information that is fit for purpose.

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