Delta Framework - Sustainability Indicators

Version 0 - currently being piloted

Introduction

The Delta Sustainability Framework aims to align sustainability monitoring and reporting within and across the cotton and coffee sectors. It provides **a common set of 15 impact and outcome indicators** to measure and report on sustainability improvements as well as **guiding principles** to gather and communicate sustainability information.

The framework builds on the work already undertaken by several commodity platforms and initiatives to define and harmonize sector-wide sustainability goals, and in particular on the **Coffee Data Standard** developed by Global Coffee Platform (GCP) and on **the Guidance Framework on Measuring Sustainability in Cotton Farming Systems** published by the Expert Panel on the Social, Environmental and Economic Performance of Cotton (SEEP)[1].

The guiding principles draw inspiration from the **ISEAL's Sustainability Claims Good Practice Guide** to communicate relevant sustainability information generated through the common set of indicators, building on the principles of reliability, relevance, clarity, transparency, and accessibility.

The framework has a strong alignment to the **Sustainable Development Goals (SDGs)** to promote the adoption of a common language and approach to the goal of achieving global sustainable agriculture.

Scope of the framework

The Delta Sustainability Framework is intended to apply worldwide to any cotton and coffee farming system, with the potential to be expanded to other agricultural commodities over time. The scope is the farm, with the single exception of the indicator on greenhouse gas emission estimation which includes cotton ginning. Results however can, and often would need, to be aggregated at higher levels to be more informative.

Most of the environmental and social impacts of agriculture are felt at a larger scale than the farm. As landscape monitoring systems using remote sensing become more accessible, the Delta Project team aims to upgrade the framework indicators and methodologies to a landscape approach (e.g. living income, deforestation risk maps, social risk maps).

The Delta Project team also fully recognises the relevance of expanding the scope of the framework to cover other segments of the value chain in future.

1 SEEP is an expert panel of the International Cotton Advisory Committee (ICAC) established in 2006: https://www.icac.org/CommitteesandNetworks/CommitteesandNetworks?CommitteeTypeId=4&MenuId=61

Intended uses

The **intended uses** of the Delta Sustainability Framework include:

- National reporting on the commitments set by the SDGs and the ratification of relevant international conventions on chemicals, climate change, biodiversity and labour rights;
- Evidence-based recommendations to streamline sustainability in agricultural policies;
- Upgrading of extension services to support continuous improvement at farm level;
- Capacity building for farmers to improve farm sustainability performance;
- Transparency and communication with consumers on the actual value of sustainably produced goods;
- Identification of business opportunities leveraging sustainable value chains.

Consultations with the sector stakeholders

The common set of indicators is the result of an intensive consultation process that began in June 2019 and engaged sustainability standards, retailers, donors, research institutes, national committees and international organisations from the agricultural sector. In addition to the project partners, the members of the Cotton 2040 platform[2], the SEEP members representing the Government of 10 countries and the European Union, the Australian Sustainability Working Group, Cotton Incorporated, the ISEAL Secretariat and some ISEAL members such as Bonsucro and Rainforest Alliance, have provided substantial input to the development of the indicators set through workshops, webinars, on-line surveys and one-to-one calls. Technical experts from the Global Soil Partnership, the Australian Cotton Research Institute and Pesticide Action Network (PAN UK) have been consulted on methodological guidance on specific indicators.

Sustainability areas and goals

Key sustainability priority areas and sub-areas for coffee and cotton production were identified at the start of the project and validated in the initial consultations held with the stakeholders. The sustainability priorities were largely drawn from existing frameworks within the cotton and coffee sectors, and in particular from the Guidance Framework developed by the SEEP Panel, the Coffee Data Standard and other nine commodity sustainability standards and initiatives[3]. A detailed account of the process followed to identify and validate priorities is provided in the desk-top research study and in the consultation report available on the Delta Project Website.

The sustainability issues covered directly link to several SDGs targets and in particular to those under SDGs 1 (no poverty), 2 (zero hunger), 3 (good health and well-being), 5 (gender equality), 6 (clean

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[2] https://www.forumforthefuture.org/cotton-2040

[3] 4C Association; Better Cotton Initiative (BCI); Cotton Connect/REEL Code; Cotton Made in Africa (CMiA); Fairtrade Foundation; International Federation of Organic Agriculture Movements (IFOAM) Organic 3.0, ISEAL Common Core Indicators; MyBMP/ Cotton Australia; and Rainforest Alliance.

water and sanitation), 8 (decent work and economic growth), 10 (reduced inequalities), 12 (responsible consumption and production), 13 (climate action), 14 (life below water) and 15 (life on land).

SDGs	Pillar	Impact area	Impact sub-area
3, 6, 12, 13, 15	Environment	Pest and Pesticide Management	**Pesticide management**
			Pest Management
		Water Management	Water quality
			Water use
		Soil Management	Soil conservation
			Soil erosion
			Fertilizer use
		Biodiversity and Land Use	**Land conversion**
			Biodiversity conservation
		Climate Change and energy use	Energy use/ **Greenhouse Gas Emissions**
			Farmers' adaptation to climate change
1, 10	Economic	Economic Viability	**Income**
			Profit/returns
			Productivity
			Price
		Economic resilience	Debts
			Asset
			Yield volatility
			Price volatility
			Payments
			Credits
		Poverty line	Poverty reduction
		Living conditions	Access to drinking water, electricity,
2, 8, 10	Social	Decent work	**Wages**
			Pensions
			Social protection
		Child labour	**Child labour/forced labour**
			Children at school
		Worker Health and Safety	**Fatalities and non -fatal accidents**
			Health care facilities
			Water/sanitation
		Equity and Gender	**Women's empowerment**
			Indigenous people
			No discrimination
		Labour rights	Democratic organisations
			Freedom of association
		Food security	Access to food

Drawing from the priority areas, cotton stakeholders have formulated nine shared sustainability goals to guide the selection of the impact and outcome indicators.

Headline impact areas	Environmentally sustainable agricultural practices (SDGs 3,6,12,13,14, 15)	Decent livelihoods/ poverty reduction (SDGs 1, 8, 10)	Social wellbeing, equality & empowerment (SDGs 2, 3, 6, 8, 10, 16)
Common goals	Minimise contamination of natural resources	Make cotton farmers and workers earn a decent income	Ensure respect human rights on cotton farms, with no forced and child labour
	Protect and regenerate ecosystem services	Be economically viable and farmers to be economically resilient	Ensure healthy & safe working conditions for all farmers and workers
	Reduce greenhouse gas emissions and build resilience to climate change	Alleviate poverty	Enhance equality and empowerment, including in gender, for cotton farmers and workers

These goals have yet to be validated with the coffee stakeholders.

The Delta sustainability indicator set

Over 200 indicators currently in use by cotton and coffee specific initiatives as well as more generic sustainability frameworks were assessed during the consultation process for their fitness to monitor progress towards the nine goals. The list of initiatives reviewed is provided in Annex 1.

As a result, the Delta Sustainability Framework comprises a core set of **15 farm-level, outcome/impact indicators across the social, economic and environmental dimensions of sustainability**. Considering the interdependences between the social, economic and environmental sustainability pillars, the set of common indicators needs to be seen as a whole.

The indicators were selected for their global relevance, usefulness and feasibility in monitoring progress towards sustainable agricultural commodities.

- **Relevance**: progress towards goals and credibility
- **Usefulness**: global commitments, comparability and aggregation, stakeholders' needs
- **Feasibility**: ease of data collection and costs.

1. Use of Highly Hazardous Pesticides
2. Pesticide risk indicator
3. Irrigation Water management
    3.1. Water extracted for irrigation
    3.2. Irrigation efficiency
    3.3. Water Productivity

4. Top Soil carbon content
5. Fertilizer use by type *(in future: Nitrogen use efficiency)*
6. Forest, wetland and grassland converted for cotton or coffee production
7. Greenhouse Gas Emissions
8. Average yield
9. Gross margin from cotton and coffee production *(in future: Living Income)*
10. Price at farmgate
11. Proportion of workers earning a legal minimum wage by gender
12. Incidence of the worst forms of Child Labour
13. Incidence of Forced Labour
14. Women's empowerment
15. Frequency of fatalities and non-fatalities on the farm by gender

Some indicators include the monitoring of practices to better interpret changes at the outcome level, e.g. good soil management practices to explain changes in organic soil content. In general, the SDG 4.2.1 guidance indicates that *measuring sustainability performances through farm practices presents several challenges. The impact of a given practice often varies 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*.

While the 15 indicators selected address sustainability issues of global relevance, several additional indicators might be required to monitor specific aspects of sustainability in local contexts. For istance, soil erosion might in some farming context be the primary cause for the deterioration of soil health and the loss of soil organic content.

General definitions

- **Farm**: All types of agricultural holdings to be taken into consideration, with the exception of hobby farms[4].
- **Family and small-scale farming** is a means of organizing agricultural production which is managed and operated by a family and predominantly reliant on family labour. (adapted from Fairtrade).
- **Small–scale producers** are farmers who are not structurally dependent on permanent hired labour and who manage their production activity mainly with family workforce.

4 The characteristics of "hobby farms" are highly context-specific. For instance, in some countries the lower bound for considering an activity as "professional" is a revenue of 1000 USD per year. In other poorer countries, the application of such lower bound would actually exclude from the set of small-scale food producers poor farmers, fisherman and forester who would deserve much attention under SDG 2.3. The only possible solution to this problem seems to be a country-specific lower bound.
Source: Sustainable Development Goal Indicators 2.3.1 and 2.3.2: http://www.fao.org/3/I8809EN/i8809en.pdf

Delta Framework

Description of the indicators

1. Use of Highly Hazardous Pesticides

Phasing out the use of highly hazardous pesticides is a shared goal of sustainability initiatives.
This indicator measures the use of Highly Hazardous Pesticides (HHPs), such as aldicarb, benomyl, carbendazim, carbofuran, dicofol, endosulfan, etoprophos, lindane, methamidophos, monocrotophos, paraquat, parathion-methyl, phorate, etc.) in cotton and coffee production. Highly Hazardous Pesticides are of particular concern due to the severe adverse effects they can cause to human health and the environment, especially in developing countries where protective personal equipment is mostly unavailable, costly and uncomfortable, where pesticides and application equipment are stored in homes, and where accidental or intentional exposure to pesticides is common.

Dimension	Environmental and social
Area(s)	Pest and pesticide management
Unit	Kg active ingredient (a.i.) of HHPs applied per ha of harvested land
Relevance	All except from farms under organic management Exclusion criterion for sustainability standards
Target	0% - A clear, time-bound plan needs to be in place to phase out the use of HHPs
Data points	• Actual quantity in kg of pesticide active ingredients applied to the crop • Harvested area in ha
Data collection	Yearly
Reporting	Yearly
Data sources	Farm records, farmer interviews. Farm level data can be crosschecked with import and pesticide industry records, cotton companies, extension officers
SDG reference	2.4.1. – 7.2 data item: Use of highly or extremely hazardous or illegal pesticides by the agricultural holding (Y/N)

Definitions

Highly hazardous pesticides:
Highly hazardous pesticides are pesticides that are acknowledged to present particularly high levels of acute or chronic hazards to health or environment according to internationally accepted classification systems such as the World Health Organization (WHO) or the Globally Harmonised System of Classification and Labelling of Chemicals (GHS) or their listing in relevant binding international agreements or conventions. In addition, pesticides that appear to cause severe or irreversible harm to health or the environment under conditions of use in a country may be considered to be and treated as highly hazardous (FAO/WHO International Code of Conduct on Pesticide Management, 2014).

The definition explicitly includes WHO Class Ia and Ib pesticides, GHS Class 1A and 1B carcinogens, mutagens and reproductive toxicity listed pesticides, pesticides listed under Annex III of the Rotterdam, Annex A and B of the Stockholm Conventions and Annexes of the Montreal Protocol and pesticide active ingredients and formulations that have shown a high incidence of severe or irreversible adverse effects on human health or the environment.

Joint Meeting on Pesticide Management (JMPM)[5] FAO/WHO criteria for highly hazardous pesticides:

1. Pesticide formulations that meet the criteria of classes Ia or Ib of the WHO Recommended Classification of Pesticides by Hazard; or
2. Pesticide active ingredients and their formulations that meet the criteria of carcinogenicity Categories 1A and 1B of the Globally Harmonized System on Classification and Labelling of Chemicals (GHS); or
3. Pesticide active ingredients and their formulations that meet the criteria of mutagenicity Categories 1A and 1B of the Globally Harmonized System on Classification and Labelling of Chemicals (GHS); or
4. Pesticide active ingredients and their formulations that meet the criteria of reproductive toxicity Categories 1A and 1B of the Globally Harmonized System on Classification and Labelling of Chemicals (GHS); or
5. Pesticide active ingredients listed by the Stockholm Convention in its Annexes A and B, and those meeting all the criteria in paragraph 1 of annex D of the Convention; or
6. Pesticide active ingredients and formulations listed by the Rotterdam Convention in its Annex III; or
7. Pesticides listed under the Montreal Protocol; or
8. Pesticide active ingredients and formulations that have shown a high incidence of severe or irreversible adverse effects on human health or the environment.

METHODOLOGICAL NOTES

List of Highly Hazardous Pesticides (HHPs). A list of HHPs reported to be used on cotton and coffee production is provided in Annex 3. It should be noted that:

- Annex 3 is a reference, not an exhaustive list of all the highly hazardous pesticides used in coffee and cotton production globally. It has been compiled based on the information available with the Delta Project Team at the time of the development of this framework.

- Annex 3 requires regular updates against revisions of hazard classifications and new chemical conventions' decisions (criteria 1 to 7).

- Annex 3 requires regular monitoring to identify pesticides that have shown a high incidence of severe or irreversible adverse effects on human health or the environment under specific conditions of use (criterion 8).

5 http://www.fao.org/agriculture/crops/thematic-sitemap/theme/pests/code/panelcode/en/

- Plans for phasing out HHPs should consider availability of alternatives, and if these are not available, the need for research (level of investment, time) to provide alternatives.

- Plans for phasing out HHPs should also consider and address potential unintended consequences as a result of their phasing out, for example the potential for over-use of alternatives and associated impacts, e.g. development of resistance.

Reporting. During the phase out period, results can be reported in reduction of kgs of each listed active ingredient used per ha of harvested land. As the 0 target is being reached, results can also be reported by area (Ha) with no use of HHPs and/or number and percent of smallholder farmers reporting phasing out of listed HHPs.

References

- FAO/ WHO International Code of Conduct on Pesticide Management, 2014:
http://www.fao.org/agriculture/crops/thematic-sitemap/theme/pests/code/en/
- FAO/WHO Guidelines on Highly Hazardous Pesticides, 2016:
http://www.fao.org/3/a-i5566e.pdf

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2. PESTICIDE RISK INDICATOR

Sustainable farming systems embrace the key principles of ecological pest management. The existence of an Integrated Pest Management (IPM) plan is a pre-requisite to drive a reduction in pesticide use and risk. This indicator aims to monitor improvement in the pesticide hazard/risk profile of the farms as an indication and a diagnostic tool that effective and ecological pest management practices have been adopted.

In the past, the indicators used to track improvement in pesticide management were the total amounts of pesticides used and the total number of sprayings. Over time, pesticide risk models and indicators, combining hazard and exposure characteristics for one or several risk categories (e.g. farm worker, air, birds, earthworms) have been developed to predict the potential risk from the use of pesticides to human health and the environment. These indicators, provided they are scientifically robust, are more informative that the actual pesticide use data per se and a viable option to help sustainability initiatives and governments tracking progress in pesticide risk reduction.

There are several complex models and indicators available to evaluate the environmental fate of plant protection products as well as occupational health and bystanders exposure risk to pesticides. For istance, the Organization for Economic Co-operation and Development (OECD) has published a comprehensive guidance document to assist policy makers in the selection of the appropriate indicators based on the protection goals that have been set.. Considering the growing global concern for pollinators, the risk-models selected should include pollinators as assessment category and be able adequately assess the risks that th use of neonicotinoids poses on bees, beneficial insects and on insectivorous bird populations.

The models currently used in the European context for pesticides registration have gained international reputation and can all be used for the purpose of this framework.

Dimension	Environmental and social
Area	Pest and pesticide management
Unit	Kg active ingredient (a.i.) of pesticides applied per ha of harvested land
Relevance	All except from farms under organic management
Target	Continuous redcution of risks to human health and the environment
Data points	• Actual quantity in kg of pesticide active ingredients applied to the crop • Harvested area in ha
Data collection	• Yearly
Reporting	• Yearly
Data sources	Farm records, farmer interviews. Farm level data can be crosschecked with import and pesticide industry records, cotton companies, extension officers
SDG reference	**2.4.1.** Proportion of agricultural area under productive and sustainable agriculture

There are however two simplified indicators, out of the several options, that are already in use within the cotton sector, namely the Environmental Toxic Load (ETL) and the Toxic Load Indicator (TLI). Both these indicators have a low data requirement (actual total pesticide use by active ingredient) and can provide estimates of the potential pesticide risk useful to improve pesticide management at the farm level. As information on actual exposure are not accounted for, both indicators do not measure the actual risk (i.e., the probability of an adverse effect on organisms).

The Environmental Toxic Load (ETL) indicator represents the average amount of toxic pressure caused by the application of pesticides on one (1) hectare of cotton in one (1) year. The ETL can only be used to evaluate the impact of changes in pesticide use on environmental hazards between years and countries. The indicator is based on the quantitative information on pesticide use and the environmental toxicity of the considered pesticides. ETL environmental categories include risk to algae, waterfleas (*Daphnia* species), fish, birds and honey bees.

The Toxic Load Indicator (TLI) is a qualitative indicator for the hazards cause by pesticide active ingredients which translates numerical and non-numerical values (toxicological endpoints, classifications) into a scoring system to measure and compare pesticide use (current use and trends). TLI environmental categories include risk to algae, waterfleas (*Daphnia* species), arthropods, fish and birds. It also includes an acute and chronic health hazard category.

Pesticide use can be reduced by adoption of agroecologically-based alternatives, including farm and landscape management measures aimed at preventing pest outbreaks. These measures focus on the preservation of ecosystem services, including natural pest control and soil health (fertility, biological activity, structure, etc) and include for instance the management of riparian areas and natural habitats to augment the population of beneficial insects.

References

- Selection Of Pesticide Risk Indicators: Guidance For Policy Makers, OECD, 2016.
http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=env/jm/mono(2016)56&doclanguage=en

3. Irrigation Water Management

This suite of indicators provides an indication of how effectively irrigation water is used on the farm. It includes the total irrigation water used, the efficiency in supplying the water used (water withdrawn or diverted from its sources versus water used) and the amount of marketable biomass produced in relation to the irrigation water used. Sustainable agriculture requires that the level of use of freshwater for irrigation does not affect water reserves. This indicator sub-set was selected from a range of options currently in use to monitor sustainable water use for their relevance and feasibility. While these indicators do not directly address the issue of water depletion, increasing water use efficiency is a key aspect of ensuring sustainable withdrawals and supply of freshwater. Irrigation systems in cotton and coffee differ from drip irrigation to surface irrigation methods. In most of the cases, there are opportunities to improve efficiency by reducing water losses.
Water quality (salinity, pollution…) is the other important aspect in water management. While establishing a water quality monitoring system is very expensive and beyond the immediate scope of this framework, aspects of water quality and pollution are addressed under the pesticide risk indicator (#2).

Notwithstanding the relevance of these water metrics to all irrigated farms, concerns remain on their feasibility in small-scale farming for both cotton and coffee where water use and soil moisture records are mostly not available. Following the initial feedback received from the first project's pilot, a simplified methodology for the collection of rainfall and soil moisture data has been developed with the support of a water specialist from the Australian Cotton Research Institute. Feasibility and costs associated with the application of these indicators remain a concern in small-farming context.
Water deficit has been proposed as a suitable measure for water management in rainfed agriculture.

3.1 Water Extracted for Iirrigation

3.2 Irrigation Efficiency

3.3 Water Productivity

Dimension	Environmental
Area(s)	Water management
Sub/ indicators Unit	3.1 Water extracted for irrigation – water extracted for irrigation (blue water) expressed as ML per hectare of harvested land [ML/ha]
	3.2 Irrigation Efficiency – expressed as the ratio of water actually required for irrigation over water extracted for irrigation [%]
	3.3 Water Productivity – expressed as yield (kilograms of cotton lint or Green Bean Equivalent (GBE)) per cubic metre[6] of water consumed per hectare of harvested land [kg/m^3]
Relevance	All farms

[6] 1 Megaliter is equivalent 1000 cubic meter

Target	Locally specific - Increase efficiency over time
SDG reference	SDG 6.4.1 Change in water-use efficiency over time. The SDG indicator measures the value added per water withdrawn, expressed in USD / m^3 over time of a given major sector (showing the trend in water use efficiency)

DEFINITIONS

Water extracted for irrigation (Blue water). All water extracted and diverted for irrigation of target crop (cotton or coffee). This metric does not account for any blue water recycled within the farm boundary or released from the farm as return flows, and therefore, assumes all blue water is consumed.

Rainfall (Green water). Local seasonal rainfall recorded during the growing season. This metric does not include an estimate of effective rain (*i.e.*, water that actually infiltrates to the root zone).

Beneficially consumed water. This is a measure of the water actually consumed by the crop and is calculated as evapotranspiration (ET_c) of the crop (as defined by FAO 56).[7]

CALCULATION

3.1 Water extracted for irrigation:

Water extracted for irrigation provides a measure of the total amount of water diverted or extracted to grow the crop. This indicator does not take into account the efficiency: either in terms of the actual production of marketable produce associated with that water use, or in terms of water losses between the point of extraction and delivery to the crop.

Formula: Total water input

3.2 Irrigation Efficiency:

Irrigation efficiency is the ratio of water actually required for irrigation over the total water diverted or extracted[8] (blue water). Water required for irrigation (the numerator of this index) is defined as the water beneficially consumed that is not delivered by rainfall, or in other words, the shortfall in crop water requirements after accounting for rainfall. Irrigation efficiency is therefore a measure of beneficially consumed blue water (numerator) over all water extracted for irrigation (denominator).

[7] Allen RG, Pereira LS, Raes D & M Smith (1998). *Crop Evapotranspiration – Guidelines for computing crop water requirements – FAO Irrigation and Drainage Paper 56*. FAO Food and Agriculture Organization for the United Nations, Rome, 1998.
[8] FAO (2017) *Water for Sustainable Food and Agriculture: A report produced for the G20 Presidency of Germany*, Food and Agriculture Organization of the United Nations. Rome, 2017

Formula: Irrigation Efficiency = $\frac{\text{Benefically consumed water } (ET_c) - \text{Rainfall}}{\text{Water extracted for irrigation}} \times 100$

3.3 Water productivity ($WP_{lint/ET}$, $WP_{lint/I+R}$)

This indicator is a measure of the marketable biomass produced in relation to the water used. Water productivity is defined here in terms of both the ratio of yield to water beneficially consumed (**$WP_{lint/ET}$**) and to the total water available to grow the crop (**$WP_{lint/I+R}$**). Water productivity in terms of water beneficially consumed (**$WP_{lint/ET}$**) is the generally favoured definition of water productivity internationally[9]. The rationale being that by focusing on the water actually consumed by the crop (ET) it 'explains the potential trade-offs and reallocation of water uses and users in a water scarce basin when increases in agricultural production are propagated'.[10] By omitting non-beneficial consumption of water, however, this metric will not show differences in efficiency of growers to the productivity of all water available.[11] For this reason we also recommend the use of the total input water productivity.

Formula: $$WP_{lint/ET} = \frac{\text{Cotton yield}^{12} \text{ (tonnes cotton lint/ha harvested land) OR GBE}}{ET_c}$$

Formula: $$WP_{lint/I+R} = \frac{\text{Cotton yield}^{13} \text{ (tonnes cotton lint/ha harvested land) OR GBE}}{\text{Water for irrigation + rainfall}}$$

This formula does not account for the biomass produced in marketable co-products, for example in cotton seed. This is particularly important when extrapolating yield/m^3 measures of water productivity to USD/m^3 measure of economic return per unit of water (as indicated under the SDG). Inclusion of an estimate of water productivity per kilogram of cotton seed per cubic metre should also be estimated for the full productivity and profitability per unit of water.

Methodological notes

It should be noted that a more accurate expression of these indicators could be achieved through the inclusion of 1) effective rain (*i.e.*, water that actually infiltrates to the root zone), 2) soil moisture consumed, 3) an account for the fate of blue water (*e.g.,* not just a measure of water diverted or extracted, but also tail water recovered and recycled, and volumes of returned flows to the

[9] FAO (2017) *Water for Sustainable Food and Agriculture: A report produced for the G20 Presidency of Germany*, Food and Agriculture Organization of the United Nations. Rome, 2017

[10] *ibid*

[11] CRDC (2019) *Australian Cotton Sustainability Report 2019: Sustainable Australian Cotton. Plant. People. Paddock.* Narrabri, Australia 2019

[12] Yield calculated as indicated under Indicator 8

[13] *ibid*

environment (including a measure of grey water), and 4) water remaining on-farm, for example in storage, and available for subsequent application to other crops outside the cotton season). The definition of indicators above is a trade-off between accuracy and research capacity to ensure that the most useful and achievable data collection can be undertaken.

Care is also necessary with the units for reporting indicators. Typical rainfall and ET are expressed in millimetres (per m^2), while irrigation water is reported in cubic metres (per m^2) or ML (per ha). Rainfall and ET need to be converted to the same units as irrigation water [m^3], when calculating Total input water, irrigation efficiency and water productivity. To convert from rainfall and ET from mm to m^3 divide by 1000; to convert irrigation water from ML/ha divide by 10. For example, 150 mm or rainfall is equivalent to 0.150 m^3 (and 1.50 ML/ha).

Beneficially Consumed Water or Crop water use is measured as the cumulative evapotranspiration (ET_c) [mm] of the crop during the growing season.[14] Evapotranspiration is a combination of two separate processes whereby water is lost from the soil surface through evaporation and used by the crop through transpiration. Cumulative ET_c is calculated following FAO 56,[15] as the daily reference evapotranspiration (ET_0) multiplied by the crop factor (K_c).

$$cumulative\ ET_C = \Sigma\ (daily\ ET_0 \times daily\ K_c)$$

While ET_o can be calculated with the FAO56 method[16], it may also be sourced from published values. K_c can be calculated with reference to remote sensing software or applications. A worked example of obtaining ET_o and Kc values, and how to use these to calculate cumulative ET_c is given in Annex 2.

Water extracted/diverted for irrigation (Blue water) This should include all water extracted or diverted from any source (river, creek, lake, pond, underground bore, well, *etc*.) to grow the crop, and should include any water used to establish the crop as well as any water used to *wet-up* the field prior to planting. All supplemental irrigation should also be counted, even if farms are otherwise considered "rainfed". The area of the field should also be known, so that the irrigation water can be expressed as a rate by hectare (or per square metre). Any other crops grown during the season should also be recorded so that the proportion of water applied to cotton can be calculated.

The amount of water applied as irrigation will vary depending on the amount of rainfall received. Rainfall is an important (even essential) component of the water required to grow the crop. It is important, therefore, that the amount of rainfall is also collected – including in rainfed farms. This will help to identify the total amount of water required to grow the crop and efficiency of the crop to convert water into yield.

Rainfall (Green water). Rainfall is most easily measured with the use of rain gauge – generally a clear plastic container with the volume marked in millimetres, mounted in the field. Following every rainfall

[14] Steduto P, Hsiao TC, Fereres E, & D Raes (2012) Crop yield response to water – FAO Irrigation and Drainage Paper 66. Food and Agriculture Organization of the united Nations, Rome 2012.

[15] Allen RG, Pereira LS, Raes D & M Smith (1998). Crop Evapotranspiration – Guidelines for computing crop water requirements – FAO Irrigation and Drainage Paper 56. FAO Food and Agriculture Organization for the United Nations, Rome, 1998.

[16] *ibid*

event during the growing season the volume of water (rain) in the gauge is checked and recorded in a diary or rainfall chart and the gauge is emptied and ready for the next rainfall event. At the end of the growing seasonal the total rain recorded is calculated as the sum of all recorded events. Rainfall can also be acquired from published meteorological data from nearby weather stations.

Soil moisture. Soil moisture can be measured with a specific appliance such as tensiometer. In the absence of any specific equipment, the **Gravimetric Weight Method** provides a good alternative to determine soil moisture content by weighing soil samples, drying them in an oven, weighing them again, and using the difference in weight to calculate the amount of water in the soil. This method is laborious and time consuming, but low-cost and rather accurate. Guidance on the use of this technique can be found in the Soil testing methods manual (see references).

If accurate soil moisture measures are not available or challenging to obtain, a modified version of WUE and WCP without the soil moisture component can be used. These are referred as partial WUE and WCP, as they are computed without the soil moisture data. Soil moisture is usually a minor component as compared to the other factors in the formula and therefore its exclusion is not expected to affect dramatically the overall trends in data. It is important, however, to specify when the partial formula has been used for comparability purposes.

Mixed systems. Cotton and coffee are often grown in spatial combination with other crops. In mixed farming systems (*e.g*. intercropped fields), crop water use and water crop productivity for cotton and coffee can be calculated based on the estimated land area under each crop grown in the field.

Rainfed cotton. Inclusion of indicators on water availability and water scarcity in combination with geo-referenced risk maps is being explored for the next version of the Delta Sustainability Framework.

REFERENCES

- FAO, 2012, Coping with water scarcity An action framework for agriculture and food security
- Benchmarking Water Productivity of Australian Cotton, 2019
  - https://www.dpi.nsw.gov.au/agriculture/irrigation/irrigation/irrigation-primefacts/benchmarking-water-productivity-of-australian-cotton-primefact
  - https://www.youtube.com/playlist?list=PL4zlvcUKKUmW1M8WN854xdpBkwg1Fpr4q
  - https://www.cottoninfo.com.au/podcasts/podcast-4-water-benchmarking-study
- Method 1: Gravimetric water content in the "Soil testing methods manual", FAO 2020 http://www.fao.org/3/ca2796en/CA2796EN.pdf

4. Top soil carbon content

This indicator measures the Soil Organic Carbon (SOC), which is the main component of Soil Organic Matter (SOM), in the top layer of the soil (0-10/30 cm) over time. Soil organic matter is increasingly being recognised for its contribution to nutrient cycling, water retention, biological function and optimising crop growth. The last Intergovernmental Panel on Climate Change (IPCC) report on climate change and land considers SOC management as one of the most cost-effective options for climate change adaptation and mitigation. Countries signatories of the United Nations Framework Convention on Climate Change (UNFCCC) are committed to monitor and report SOC stock changes. Sustainable agricultural systems therefore integrate practices aimed at conserving soil resources and enhancing soil carbon content. On the contrary, large-scale monocultures, if not properly managed, can negatively impact soil health as a result of reduced soil biodiversity and increased erosion.
Changes in SOC generally occur over many years, and it is often difficult to identify small changes.

Dimension	Environmental
Area(s)	Soil health and Climate Change
Unit	Grams of organic carbon per tonne soil per ha of harvested area
Relevance	All farms
Target	Stable or higher SOC over time
Data points	• Soil carbon content • Soil bulk density • Havested area in ha
Data collection	Yearly visual assessments and laboratory tests every 5 years
Reporting	5 years
Data sources	Visual assessments, laboratory tests
SDG reference	15.3.1 Proportion of land that is degraded over total land area

Definitions

Soil organic matter (SOM). The term SOM is used to describe the organic constituents in soil in various stages of decomposition such as tissues from dead plants and animals, materials less than 2 mm in size, and soil organisms. SOM is critical for the stabilization of soil structure, retention and release of plant nutrients and maintenance of water-holding capacity, thus making it a key indicator not only for agricultural productivity, but also environmental resilience. SOM contains roughly 55–60 percent C by mass (FAO, 2017).

Soil organic carbon (SOC). Soil organic carbon (SOC) is the main component of soil organic matter (SOM). SOC refers only to the carbon component of organic compounds. SOC improves soil structural stability by promoting aggregate formation which, together with porosity, ensure sufficient aeration and water infiltration to support plant growth (FAO, 2017).

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METHODOLOGICAL NOTES

Determination of organic soil concentration with the current methods in use remain complex and expensive. Therefore, the indicator combines **yearly visual assessments of soil color and biological activity** for monitoring purposes, with **actual topsoil testing every 5 years that can be reported**. It is also recommended to monitor soil management practices to reduce soil erosion and soil fertility losses.

Visual assessment: The simplest method for visual assessment and colour determination is the Munsell Notation System. The soil testing methods manual provides guidance on assessing soil color with farmers (see references). A more accurate but expensive method is the portable spectrophotometer (CieLab color) which avoids the human error associated with the interpretation and/or perception of the colour of the sample.

The laboratory selected for the soil test will provide a protocol to collect and prepare the soil samples. The same soil sample can be used to perform both the visual and the laboratory tests. It is therefore important that 1. the field areas from where the soil samples are collected are clearly marked and recognisable over the years; and 2) the soil visual assessment is performed on each individual soil sample before it is further manipulated or disturbed.

A step-wise approach is proposed to carry out the visual assessment:

Step 1 – Sample the first 0-15 to 20 centimetres of soil with a trowel, avoiding soil disturbances as much as possible. The soil should sampled prior to the any organic or inorganic fertilization.The same soil sample can be used for the laboratory test following the procedures provided by the reference laboratory. Soil samples should be taken from the same field areas every year to be comparable;

Step 2 – Prepare the sample for the colour reading. The sample should be moist, not wet or dry;

Step 3 – Read and record the soil sample colour using a Munsell chart. Optimal field conditions to determine the soil colour are under natural light on a clear, sunny day at midday, without wearing sunglasses. The reading should not take too long;

Comprehensive, practical guidance on how to use the Munsell soil colour charts, including the preparation of the sample, is provided by the Munsell official site and in the video and power point presentation listed under the references;

Step 4 – Estimate the organic carbon content based on the Munsell soil colour value using the values reported in the table below;

Step 5 – Compare results from step 3 with the results from the laboratory test to re-calibrate the visual assessment and establish a baseline in the first year. As results from the laboratory can take up to 14 days, the soil sample used for the visual assessment need to be preserved or a new sample collected to "re-calibrate" the visual assessment;

Step 6 – Repeat the procedure every year comparing previous readings for an increase or decrease in soil organic content by looking at the change in colour (checking if the colour has deepened using the Munsell colour book).

Estimation of organic matter content (SOC) based on Munsell soil colour (FAO, 2006)[17].

Colour	Munsell value	Moist soil			Dry soil		
		S	LS,SL,L	SiL,Si,SiCL,CL, SCL,SC,SiC,C	S	LS,SL,L	SiL,Si,SiCL,CL, SCL,SC,SiC,C
		(%)					
Light grey	7				<0.3	<0.5	<0.6
Light grey	6.5				0.3-0.6	0.5-0.8	0.6-1.2
Grey	6				0.6-1	0.8-1.2	1.2-2
Grey	5.5			<0.3	1-1.5	1.2-2	2-3
Grey	5	<0.3	<0.4	0.3-0.6	1.5-2	2-4	3-4
Dark grey	4.5	0.3-0.6	0.4-0.6	0.6-0.9	2-3	4-6	4-6
Dark grey	4	0.6-0.9	0.6-1	0.9-1.5	3-5	6-9	6-9
Black grey	3.5	0.9-1.5	1-2	1.5-3	5-8	9-15	9-15
Black grey	3	1.5-3	2-4	3-5	8-12	>15	>15
Black	2.5	3-6	>4	>5	>12		
Black	2	>6					

Note: if chroma is 3.5-6, add 0.5 to value; if chroma is > 6, add 1.0 to value

C	Clay	S	Sand	SiC	Silty clay
CL	Clay loam	SC	Sandy clay	SiCL	Silty Clay Loam
L	Loam	SCL	Sandy clay loam	SiL	Silt Loam
LS	Loamy sand	Si	Silt	SL	Sandy loam

Laboratory testing protocols: The Global Soil Laboratory Network (GLOSOLAN) has been recently established to harmonize existing soil laboratory procedures, standards for results' interpretation and provision of recommendations to farmers. The Delta Sustainability Framework will align with the Standard Operating Procedures (SOPs) proposed by GLOSOLAN to harmonize organic and total carbon

[17] Table adapted from Schlichting, Blume and Stahr, 1995

measure. SOPs offer step-by-step instructions on how to perform laboratory analyses. For SOC the Walkley-Black method (Titration and colorimetric method) and the Dumas dry combustion method are recommended. The Walkley-Black method, used since the 1930's, remains the most common method despite the concerns associated with the use of chromic acid to measure the oxidizable organic carbon. With the upgrading of soil testing laboratories, the Dumas method might become the prevalent method.

Most commercial soil tests report soil organic carbon results as a percentage, which translates directly as the weight of soil organic carbon (in grams) per 100 grams of oven-dried soil (gr C/100 gr soil).

x.xx% soil organic carbon = x.xx gr carbon per 100 gr soil = xx.x gr carbon per kg soil = xxx kg carbon per tonnes soil.

Soil sampling procedures: the laboratory will provide specific protocols to collect and prepare the soil samples.

Soil bulk density (g/cm3): An accurate measurement of changes in organic carbon might require an estimate of bulk density of the soil to adjust for changes in soil mass at specified depth intervals. Bulk density is the weight of soil in a known volume and it reflects the total soil porosity. Soils often experience changes in bulk density (BD) over time due to the adoption of a new management practice such as zero tillage, or the introduction of mechanization, or through natural processes such as compaction or erosion. In these cases, it is necessary to adjust any carbon stocks to an equivalent soil mass. A higher soil bulk density means a greater weight of soil for the same depth.

There are several methods of determining soil bulk density. The most common method is to obtain a known volume of soil using a metal ring pressed into the soil (intact core), dry it to remove the water, and weigh the dry mass. The bulk density is the dry weight in grams divided by the volume in cubic centimetres. *Bulk density* (g/cm^3) = *Dry soil weight (g) / Soil volume* (cm^3). For a step-wise guidance to measure soil bulk density refer to the factsheet on Bulk Density—MEASURING.

Adjusting soil organic carbon content for soil bulk density requires a simple calculation:
Example: Soil sample depth (0–10 cm); 1.3 g/cm3 bulk density; 1.2% organic carbon
10,000 m2 in one hectare x 0.1m soil depth x 1.3 g/cm3 bulk density x (1.2/100) = 15.6 tonnes carbon hectare. GRDC-Managing-Soil-Organic-Matter-Web.pdf.

Reporting units. Soil organic carbon makes up about 58 per cent of the mass of organic matter and is usually reported as the concentration (i.e. per cent) of organic carbon in soil. Different reporting units may however be used, which are easily convertible.

Good soil management practices include:

1. Use of cover crops and/or perennials in crop rotations;
2. Implementing crop rotations with more crops;

3. Effective (e.g. appropriate application rate, time and method) use of organic amendments , such as animal manure, compost, digestates, biochar;
4. Balanced fertilizer applications with appropriate and judicious fertilizer application methods, types, rates and timing;
5. Managing crop residues: using forage by grazing rather than harvesting, applying mulches or providing the soil to give permanent cover;
6. Reducing tillage events and intensity and/or adopting new residue management techniques, minimum or no-tillage;
7. Landform management modification such as those implemented for erosion control (e.g. terraces), surface water management, and drainage/ flood control.

References

- Munsell Notation System: https://munsell.com/about-munsell-color/how-color-notation-works/
- Practical guidance to read soil color Munsell charts: Microsoft PowerPoint - ACT01_COLOR_INT-09-13 [Compatibility Mode] (floridahealth.gov) Munsell Soil Color Chart - YouTube
- Soil testing methods manual. Soil Doctors Global Programme. A farmer-to-farmer training programme. FAO, 2020. ISBN 978-92-5-131195-0: http://www.fao.org/3/ca2796en/CA2796EN.pdf
- Soil Organic Carbon, the hidden potential, FAO, 2017. SBN 978-92-5-109681-9 http://www.fao.org/3/a-i6937e.pdf%20
- Standard Operating Procedure (SOPs) for Soil Organic Content. Walkley-Black method (Titration and colorimetric method), FAO, 2020: http://www.fao.org/3/ca7471en/CA7471EN.pdf
- Guidelines for soil description, FAO, 2006. ISBN 92-5-105521-1: Guidelines for soil description (fao.org)
- Factsheet on Soil Bulk Density – MEASURING, Healthy Soils for Sustainable Farms programme, Australia: Phys_-_Bulk_Density_Measurement_web.pdf
- Global Soil Partnership Website: http://www.fao.org/global-soil-partnership/pillars-action/5-harmonization/glosolan/en/
- Voluntary Guidelines for Sustainable Soil Management, FAO, 2017: bl813e.pdf (fao.org)

5. Fertilizer use by type (Nitrogen Use Efficiency in future)

This indicator provides data on inorganic fertilizers, in terms of nutrient content, for the three crop nutrients: Nitrogen (N), Phosphorus (P) and Potassium (K). An accounting of synthetic fertilizer types and quantities represents a proxy for understanding soil management practices and quality. Although it does not *per se* capture the efficiency of the application, it is relevant to pollution prevention strategies. In future, this indicator might also include organic fertilizers, in alignment with the Coffee Global Standard.

Dimension	Environmental
Area	Soil management and Climate Change
Unit	Kg active ingredients of types of fertilizer (N,P,K) per ha of harvested land
Relevance	All except from farms under organic management
Target	Increased nitrogen use efficiency (suggested measure yield (kg/ ha) /kg of fertiliser N)
Data points	• Kg of fertilizer products used • Fertilizer conversion factors for: - Nutrient nitrogen N kg / ha - Nutrient phosphate P2O5 kg /ha - Nutrient potash K2O kg / ha • Harvested area in ha • Yield • Crop residue management practices
Data collection	Yearly
Reporting	Yearly
Data sources	NPK fertilizer applications/purchases
SDG reference	2.4.1. - management of fertilizer

Methodological notes

Fertilizer conversion factors. In the case that specific values to convert tonnes of fertilizer product used into nutrient concentration are not available, **a fertilizer converter tool is provided** in the webpage of the **International Fertilizer Association.**

Nitrogen use efficiency: There are multiple ways to analyse Nitrogen Use Efficiency as inputs (kgs of total nitrogen applied) per output (Kgs of lint cotton harvested or ha of lint cotton harvested). Nitrogen Use efficiency can also be calculated as lint yield (kg/ ha) divided by the total amount of fertiliser N applied.

Good management measures to improve fertilizer management and use efficiency include:

- Follow protocols as per extension service or retail outlet recommendations or local regulations, not exceeding recommended doses;
- Use soil sampling to perform nutrient budget calculations;
- Perform site-specific nutrient management or precision farming (where possible);
- Use an organic source of nutrients (including manure or composting residues) alone, or in combination with synthetic or mineral fertilizers;
- Use legumes as a cover crop or intercrop to reduce fertilizer inputs; and
- Consider soil type and climate in deciding fertilizer application doses and frequencies.

References

- International Fertilizer Association: https://www.ifastat.org/

Delta Framework

6. FOREST, WETLAND AND GRASSLAND CONVERTED FOR COTTON OR COFFEE PRODUCTION

This indicator measures the conversion of any natural land (e.g., forest, wetland, grassland) to land used for cotton or coffee production. The term forests refers to both primary and naturally regenerating forests. Most of the forest loss takes place in tropical forests which host at least two thirds of the terrestrial species. Stopping deforestation contributes to reducing impacts of climate change as forests absorb carbon dioxide from the atmosphere and store it as biomass.

Dimension	Environmental
Area	Biodiversity and Climate Change
Unit	Ha of forest, wetland or grassland converted to cotton or coffee production
Relevance	All farms
Target	0% - Exclusion criterion for sustainability standards
Data points	• Land area (in ha) and proportion of the farm that was converted from natural land (e.g., forest, wetland, grassland and savanna) to land used for cotton or coffee production in the last 5 years.
Data collection	Yearly
Reporting	Yearly
Data sources	Farmers' interviews, secondary data and GPS maps
SDG reference	15.1 Forest area as a proportion of total land area

DEFINITIONS

Forest: is a land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use.

Naturally regenerating forest: forest predominantly composed of trees established through natural regeneration.

Primary forest: Naturally regenerated forest of native tree species, where there are no clearly visible indications of human activities and the ecological processes are not significantly disturbed.

Wetland: Areas of marshes, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is flowing or static, fresh, brackish or salty, including areas of marine water the depth of which at low tide does not exceed six metres (Definition in the Ramsar Convention)

Grassland: Definitions of grassland and the associated term "range" are multitude, many with specific local legal connotations; the Second Expert Meeting on Harmonizing Forest -related Definitions for use by Various Stakeholders (FAO, 2000) gives eleven pages of them. The Oxford Dictionary of Plant

Sciences (Allaby, 1998) gives a succinct definition: Grassland occurs where there is sufficient moisture for grass growth, but where environmental conditions, both climatic and anthropogenic, prevent tree growth. Its occurrence, therefore, correlates with a rainfall intensity between that of desert and forest and is extended by grazing and/or fire to form a plagioclimax in many areas that were previously forested."

FAOSTAT divides the data between:

Temporary meadows & pastures: Land cultivated for a period of less than five years for growing herbaceous forage crops for mowing or pasture. A period of less than 5 years is used to differentiate between temporary and permanent meadows;

Permanent meadows & pastures: Land used permanently for grazing (five years or more) which includes herbaceous forage crops, either cultivated or growing wild (wild shrubs, wild prairie or grazing land).

Methodological notes

Geo-referenced risk maps. The Global Coffee Data Standard suggests overlaying GPS coordinates of farms with regional deforestation maps to understand areas at risk. Note though that usually only a single GPS point will exist for many smallholder farms, meaning that there often isn't sufficient information to track the contribution of individual farms to deforestation in most cases. However, even with single GPS points, general farming areas prone to deforestation will still be visible.

References

FAO's Forest Resource Assessment (FRA) 2020 Terms and Definitions Document
http://www.fao.org/3/I8661EN/i8661en.pdf

7. GreenHouse Gas emissions

This indicator is defined as the ratio between CO2 equivalent emissions from agricultural activities and the marketable biomass produced: cotton lint or Green Coffee Beans (GBE).
The scope of this indicator includes direct and indirect emissions (1.2 and 3) including all emissions occurring upstream and at the farm from cotton production and until the ginning process. Soil carbon sequestration is not included at this stage.

Dimension	Environmental
Area	Climate Change
Unit	Kg CO2e / kg cotton lint or GBE
Relevance	All farms
Target	Decrease of CO2e until reaching carbon neutrality
Data points	• Kg of fertilizer products used/ha • Kg of pesticide products applied/ha • # of pesticide applications • Soil Organic Matter • Soil Ph • Soil type: clay, silt, sand % • Energy use (kWh and fuel) used/ha • Rainfall • Temperature: Minimum, average, maximum • Total water use • Irrigation system • Soil draining capacity (good or poor) • Transport of inputs
Data collection	Yearly
Reporting	3 years
Data sources	Farmers' interviews and secondary data
SDG reference	13.2.2 Total greenhouse gas emissions per year

Similar to the pesticide risk indicator, several tools have been developed to quantify on-farm greenhouse gas emissions. The Field to Market Alliance for Sustainable Agriculture has developed a tool called Fieldprint Platform, which includes GHG emissions. The Fieldprint is based on national datasets and therefore relevant to cotton farming in USA. Australia has developed a specific GHG tool for cotton GHG emissions. Another user-friendly option for cotton and coffee is the Cool Farm Tool. The tool is suitable for farm-level estimates and flexible in the definition of the assessment boundaries. A complementary tool is the geoFootprint which is developed to map and visualize crop carbon footprints at a larger scale (coffee is not included at this stage). A comparison of the scope of the two tools is reported in the table below.

Cool Farm Tool	GeoFootprint	Fieldprint Calculator
Scope		
User-defined system boundaries, i.e. GHG footprint is calculated for the elements recorded by the end user and only those	Scope 3 at the farm exit gate (i.e. including all emissions occurring upstream and at the farm). Default data are provided	Energy use, nitrous oxide emissions from soils, methane emissions (rice only) and emissions from residue burning.
Farm level (even plot level), without default data. All must be recorded by the end-user	Default data are provided for every parameter at maximum granularity of 10x10 km. All defaults except soil characteristics can be overwritten to recalculate customized emission factors	The Fieldprint® Platform uses standard U.S. government assumptions regarding fuel use, such as the 22.3 pounds of CO_2e that are emitted per gallon of diesel combusted.
Focus on GHG emissions. Includes calculation for water footprint and biodiversity indicators (in progress)	Multiple indicators: climate change (GHG emissions), water withdrawal, water scarcity, eutrophication potential, acidification potential, biodiversity loss, ecosystems quality, soil organic carbon change, soil erosion	Multiple indicators: GHG emissions, water quality, irrigation water use, biodiversity soil organic carbon, soil erosion, land use, energy use.

References

- GeoFootprint: www.geofootprint.com
- Cool Farm Tool: www.coolfarmtool.org/
- Field to Market: Fieldprint Platform - Field to Market

8. Yield (average)

High productivity (yield) is likely to lead to better economic returns and to reduce pressure on increasingly scarce land resources, commonly linked to deforestation and associated losses of ecosystem services and biodiversity.

Dimension	Economic
Area	Economic profitability
Unit	Kg cotton lint or GBE per ha of harvested land
Relevance	All farms
Target	Increased or stabilized yield over time
Data points	• Kg cotton lint or GBE harvested • Total areas havested (Cotton harvested area or Coffee productive land) • Conversation factors to lint and to GBE
Data collection	Yearly
Reporting	3-year average
Data sources	Farm cash records, farmer interviews
SDG reference	SDG 2.4.1. Percentage of agricultural area under productive and sustainable agriculture

Methodological notes

Conversion factors

Seed cotton conversion to cotton lint. This indicator requires conversion from seed cotton to cotton lint in countries where yield is measured in kg of seed cotton, which includes the weights of both the seeds and the lint. If local conversation coefficients are not available, ICAC publishes ginning percentages for 37 cotton producing countries which can be requested from the ICAC Secretariat and used to convert seed cotton production to lint. In case of multiple pickings, the average yield is calculated.

Coffee amount harvested. Coffee amount harvested requires local unit conversion to kgs. The main coffee forms considered are Dried Cherry, Parchment and FAQ (cleaned/re-processed). Amount sold can be a suitable proxy where harvested amounts are unknown (i.e., many smallholders will only know production volumes when their product is weighed at the mill).

References

- ICAC Cotton Data Book, 2020
- ICO conversion factors: http://www.ico.org/documents/cy2016-17/conversion-factors-e.pdf

9. Gross margin from cotton and coffee production (Living Income in future)

This indicator tracks the crop profitability as an important dimension of its economic sustainability. The indicator calculates the average gross margin from seed cotton or coffee minus the cost of production. Gross margin analysis represents the most widespread basis for farm planning of the next year's production. The gross margin (GM) is the profit that each crop contributed to a farm's aggregate profit and is calculated for each crop as the difference between the income/ha and variable costs associated with each crop. The indicator therefore measures the net operating income generated by cotton or coffee, as distinct from the total income of the farming household, which can also include remittances and off-farm income.

Dimension	Economic
Area	Economic viability
Unit	USD per ha seed cotton or coffee
Relevance	All farms
Target	Increasing returns over time
Data points	• Cost of cultivation (inputs and operational costs) • Gross income (from the selling of the crops and by-products marketed) on seed cotton and GBE • Cotton harvested area or Coffee productive land in ha • Currency conversions rates to USD
Data collection	Yearly
Reporting	3- year average
Data sources	Farm cash records, farmer interviews
SDG reference	SDG 1 No poverty

Definitions

Cost of cultivation. Cost of cultivation includes all input costs and manpower/operational costs associated with the inputs. It however does not include ginning cost, land rent, taxes, etc.

Operational costs. The operation costs include:

- Tools[18] needed to apply the inputs
- Electricity/diesel
- Transportation
- Labour

[18] Tools would only be included if they are used up during the season (one year) and disregardded at the end of the production season and are not used in the subsequent season.

- Consultants cost (wherever applicable)

Gross income. Gross Income is the income generated through the selling of seed cotton (includes lint and seeds) or GBE.

Net average returns. Net average returns on seed-cotton or coffee per ha are calculated as gross income on seed cotton or GBE minus the total cost of cultivation.

METHODOLOGICAL NOTES

The computation of net returns requires basic financial transactions which are usually maintained in large commercial farms, but not often in small scale farming. If farm records are not available, returns can be estimated based on farmer declaration of outputs and inputs quantity and value.

Currency conversation into USD: the International Monetary Fund (IMF) provides official exchange rates on a monthly basis**:**
https://www.imf.org/external/np/fin/data/param_rms_mth.aspx

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10. Price (at farmgate)

This indicator refers to the average price received per tonne of seed cotton or coffee (GBE).

Dimension	Economic
Area	Economic viability
Unit	Local currency per tonne of seed cotton or coffee (GBE)
Relevance	All farms. Relevant to premium-based standards only.
Target	Price stability (tentative)
Data points	• Prices for each sale
Data collection	Yearly
Reporting	3- year average
Data sources	Farm cash records, farmer interviews
SDG reference	SDG 1 No Poverty

Methodological notes

Multiple sales. For multiple sales, calculate the average price of sales. The average price can then be compared to the global reference price (e.g. ICAC, ICO). This approach avoids the additional time and resources necessary for detailed accounting and asking about each sale (and the associated premiums, deductions or bonuses) while still providing good results.
For countries like USA, BRAZIL, AUSTRALIA values will be provided for lint and cotton seed and converted into seed cotton.

11. Proportion of workers earning a legal minimum wage by gender

This indicator allows identifying farms that do not pay a fair remuneration to all employees. The wages paid are an indication of the economic risk faced by unskilled workers in terms of remuneration received, the later benchmarked against the minimum wage set at national level in the agricultural sector. All living wages or wages of all workers and employees should be equal or above existing official national minimum wages or sector agreements, whichever is higher.

Dimension	Social
Area	Labour rights
Unit	Daily average earnings for farm labour compared to (rural) minimum wage in local currency and also expressed as a percentage of the rural minimum wage (where that exists), alternately to the national minimum wage
Relevance	Farms that employ hired labour; not applicable to farms that employ only family labour
Target	100% compliance - Entry criterion for sustainability standards
Data points	• Total labour cost in the last 12 months/season • # hired (permanent and temporary) workers working on the farm in the last 12 months/season • Total labour cost in the last 12 months/season • Average daily wage rate paid to each worker • National minimum wages • Currency conversion rates
Data collection	Yearly
Reporting	Yearly
Data sources	Work contracts, farmer interviews
SDG reference	8.5.1 Average hourly earnings of female and male employees, by occupation, age and persons with disabilities

Definitions

Agricultural skilled workers. Skilled agricultural workers grow and harvest field or tree and shrub crops; in order to provide food, shelter and income for themselves and their households. A full description of tasks performed by agricultural skilled workers is provided in the Sub-major Group 61 Market-oriented Skilled Agricultural Workers of the International Standard Classification of Occupation (ISCO) classification.

Wages. Compensation includes both monetary and in-kind payment.
Definitions adapted from Fairtrade Standard for Small-scale Producer Organizations:

Workers. In the context of the Delta framework, workers are all workers including migrant, temporary, seasonal, sub-contracted and permanent workers. Workers are waged employees hired to work in the field.

Migrant worker. A migrant worker is a person who moves from one area within her or his own country or across the borders to another country for employment. A migrant worker works for a limited period of time in the region that he/she has migrated to. Workers are not considered migrant after living one year or more in the region where they work, and if either a permanent position has been granted by the employer or legal permanent resident status has been granted.

Seasonal worker. Seasonal worker refers to a worker whose work by its character is dependent on seasonal conditions and is performed only during part of the year.

Temporary worker. A temporary worker is a person who works at the company on a non-regular, short term basis. A temporary worker may be a seasonal worker.

References

- International Standard Classification of Occupation (ISCO-08 - code 92) https://www.ilo.org/public/english/bureau/stat/isco/docs/groupdefn08.pdf
- ILO Minimum Wage Fixing Convention, 1970 (No. 131) https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100_INSTRUMENT_ID:312276

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- ILO Minimum Wage Fixing Convention, 1970 (No. 131) https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100_INSTRUMENT_ID:312276

12. Incidence of the worst forms of child labour

This indicator tracks the employment of children below the age of 15 or under the age defined by local law, whichever is higher. Child labour is "work that deprives children of their childhood, their potential and their dignity, and that is harmful to physical and mental development". Not all work carried out by children is considered child labour. Some agricultural tasks may help children acquire important livelihood skills and contribute to their survival and food security. However, many child labourers in agriculture are trapped in hazardous work. Child labour in cotton and coffee production has been reported in several countries, primarily as a consequence of the low farm income.

Assessing child labour in the field remains complex and sensitive. Opportunities for collaboration with UN dedicated agencies such as FAO and ILO are a real opportunity which should be explored in many countries.

Dimension	Social
Area	Child Labour
Unit	Number of children aged 5–17 years engaged in child labour, by gender and age
Relevance	All farms
Target	0% - Exclusion criterion for sustainability standards
Data points	• Age of the child • Working tasks of the child (to be contextualised to the farming conditions) • Working hours per day/week (or average hours) • Hazards associated with the agricultural tasks Additional relevant data: • Impacts of the child's work on their health • Impacts of the child's work on their education (regular access to school, age and education level)
Data collection	Yearly
Reporting	Yearly
Data sources	Secondary data on child labour (if existing) Interview with farmers; interview with children; household survey; school attendance monitoring.
SDG reference	8.7.1 Proportion and number of children aged 5-17 years engaged in child labour

Definitions

Child labour. Child labour is defined by ILO as work that impairs children's well-being or hinders their education, development and future livelihoods. The Convention on the Rights of the Child (UN, 1989) recognizes and emphasizes the child's right to education and the right of the child to be protected from economic exploitation and from performing any work that is likely to be hazardous, interfere with the child's education, or be harmful to the child's health or physical, mental, spiritual, moral or social development.

The international regulations and Conventions dealing with child labour refer to the following distinctions/concepts:

- Working children
- Child labour
- Age-appropriate tasks
- Light work
- Worst forms of child labour
- Hazardous work

Minimum age. The ILO Minimum Age Convention, 1973 (No. 138) specifies the minimum age for different types of employment:

- 13 years for light work
- 15 years for ordinary work
- 18 years for hazardous work

Developing countries that ratified Convention No. 138 have the option to designate a higher age or, in exceptional cases, an age 1 year lower than the standard (e.g. 14 years for ordinary work).

- Age-appropriate tasks become "child labour" when children:
- Are too young for the work they are undertaking;
- Work too many hours for their age;
- Undertake work of a hazardous nature or in hazardous conditions;
- Work under slave-like conditions; or
- Are obliged to undertake illicit activities.

Hazardous work. Hazardous work in the context of crop production includes **exposure to sharp tools and dangerous machinery,** injuries from animals, **exposure to extreme environmental conditions, exposure to agrochemicals, long working hours in fields** (especially in extreme weather conditions); and physically strenuous or repetitive activities. Hazardous work is an example of the **worst forms of child labour** (ILO Convention, 1999 (No. 182). For all full description of the definitions refer to the FAO Handbook.

Family labour: Children below 15 years of age only work after school or during holidays, the work they do is appropriate for their age and physical condition, they do not work long hours and/or under dangerous or exploitative conditions and their parents or guardians supervise and guide them.

Methodological notes

Monitoring child labour is a complex issue. The FAO Handbook for monitoring and evaluation of child labour in agriculture includes a toolkit designed to assess and gather data on child labour in family-based agriculture. It is recommended to use a combination of different tools during data collection, in order to obtain diverse data which can be cross-checked against each other. With a combination of

tools, the strengths of one can overcome the potential weaknesses of another, and the data obtained are therefore more reliable.
Standard setting initiatives can monitor the incidence of child labour based on audits and additional qualitative assessments.

Rainforest Alliance has adopted the Child Labor And Forced Labor Sectoral Risk Maps developed by Ergon Associated which evaluate sector risks per country for child and forced labor. These risk assessments are indicative tools to identify where there is a high, medium or low risk of the scoped labor rights abuses in specific crops in relevant producer countries. These are meant for use to adapt mitigation actions to risk context and to adapt requirements and assurance activities based on the risk level. Overall, these indices represent a preliminary country-base exercise and do not factor in sub-national variations or data about individual producers' performance. There are two indices developed as the risk maps for child labor and forced labor. The three key steps to develop an index are:data sources: structural risks, country/crop desk research: risk in practice/ scoring/compilation.

Reporting

The elimination of child labour from agriculture is a shared goal by the private and public institutions. and for the sustainability standard this is an exclusion criterion. While this is an exclusion indicator for any standards claiming sustainable practices, for countries where child labour is a significant reality, the path towards its complete elimination is often quite long and closely linked to the overall economic development of rural areas. In this context, tracking reduction in the incidence of child labour is an important assessment of the effectiveness of the reforms enacted.

- Reduction in percentage of children under the legal working age
- Reduction in percentage of children engaged in hazardous work

References

- FAO Handbook for monitoring and evaluation of child labour in agriculture provide a step-wise guidance to monitor child labour
  http://www.fao.org/3/a-i4630e.pdf

13. Incidence of forced labour

This indicator tracks the systematic or individual use of forced labour in cotton and coffee production. Forced Labour remain a problem in many parts of the world, including in countries were cotton and coffee are grown.

Dimension	Social
Area	Forced Labour
Unit	Number of people, over 17 years of age, engaged in forced labour, by gender and age.
Relevance	Countries with reported incidence of forced labour
Target	0%. Exclusion criterion for sustainability standards
Data points	Example of variables used to estimate risk : ✓ poverty ✓ migration ✓ informal economy ✓ legislative framework
Data collection	Yearly
Reporting	Yearly
Data sources	Secondary data (if existing) and *ad hoc* surveys
SDG reference	8.7 Take immediate and effective measures to eradicate forced labour

Definitions

Forced labour. Forced labour includes all work or service: - which is not voluntary; and - which is exacted under the menace of a penalty, slavery and abduction, misuse of public and prison works, forced recruitment, debt bondage, domestic workers under forced labour situations, and internal or international human trafficking for labour or sex purposes. A person is classified as being in forced labour if engaged during a specified reference period in any work that is both under the threat of menace of a penalty and involuntary. ILO Forced Labour definitions, include the unconditional worst forms of child labour (as specified in ILO 182)

Work: Work is any activity performed by persons of any sex and age to produce goods or to provide services for use by other or for own use.

Involuntary work: Involuntary work is any work taking place without the free and informed consent of the worker.

Threat or menace of any penalty: Threat or menace of any penalty is any means of coercion used to impose work on a worker against his or her will.

Reference period. The reference period can be short such as last week, last month or last season, or long such as past year, past five years or lifetime.
ILO Forced Labour Convention, 1930 (No. 29)

Methodology

Forced labour in a country or in a specific sector is usually monitored under the auspices of international, human rights agencies and collaborative Governments. Standard setting initiatives monitor the incidence of forced labour based on audits and additional qualitative assessments.

These monitoring approaches primarily estimate levels of contextual risk of forced labour based on specific variables, e.g. poverty, migration, informal economy, legislative framework.

The Responsible Business Alliance has developed the Supplemental Validated Audit Process (SVAP) on Forced labor based exclusively on identifying the risk of forced labor at an Employment Site (e.g. factory) or Labor Provider (e.g. labor agent or recruitment agency). The elements of the SVAP audit are constructed to create a specialized assessment program, limited in scope to only focus on provisions related to forced labor.

Another example of a risk-based, on-the-ground forced labour monitoring can be found in Uzbekistan. International monitors and human rights activists have monitored force labour in the cotton growing in the country for a few years Districts are selected based on the index of availability of voluntary pickers, developed by the ministerial Centre of employment research. The index is based on two indicators: 1) availability of the working-age population in the district, and 2) production of raw cotton, in tons, in the district. According to the Centre's methodology, if the index is lower than 3 people per ton, the district has a shortage of agricultural workers/cotton pickers. Randomly generated GPS coordinates were selected in a rural area of the selected districts. Monitors received the coordinates early morning of each working day via secure messenger (e.g. telegram). Farmers were not notified in advance. Monitors asked for consent from the farmer to fill out the checklist and to distribute the information lists among all pickers with key information about the study and the invitation to approach the monitors directly in the field or via the provided phone number. To those interested in taking part, a consent form was provided and explained in detail. Interviews were conducted only with those respondents who provided the informed consent.

For risk-based method see also the Child Labor And Forced Labor Sectoral Risk Maps.

As a general principle, monitoring should never cause harm to impacted communities and to those wishing to be part of any voluntary self-governing system on forced labour.

References

- ILO Forced Labour Convention, 1930 (No. 29) https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100_ILO_CODE:C029
- Third-party monitoring of child labour and forced labour during the 2019 cotton harvest in Uzbekistan https://www.ilo.org/wcmsp5/groups/public/---ed_norm/---ipec/documents/publication/wcms_735873.pdf

14. Women's Empowerment

With reference to SDG 5: "Achieve gender equality and empower all women and girls", the Delta Project stakeholders identified women's empowerment as a social impact sub-theme. Women's Empowerment is the combined effect of changes in a women's own knowledge, skills and abilities (agency) as well as in relationships through which she negotiates her path (relations) and the society norms, customs, institutions and policies that shape her choices and life (structures).[19]
This composite indicator for women's empowerment, developed in partnership with CARE International UK with reference to the IFPRI Women's Empowerment in Agriculture Index20, is made up of 6 tried and tested sub-indicators across three domains: leadership, decision-making and control of economic assets.

Dimension	Social
Area	Gender
Unit	Composite indicator
Relevance	All farms
Target	Increased women's empowerment
Data points	• Self-efficacy • Communication and negotiation skills • Collective action • Input into productive decisions • Control of productive assets • Gender equitable attitudes
Data collection	Yearly
Reporting	Yearly
Data sources	Household interviews
SDG reference	5.5 Ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic and public life

Definitions

Leadership: The capacity of women to speak up and be heard, and to shape and share in discussions, discourse, and decisions. It is measured by 3 sub-indicators:

- Self-efficacy: # women and # men reporting high levels of self-efficacy
- Communication and negotiation skills: # women and # men reporting confidence in their communication and negotiation skills

[19] Gender Equality and Women's Voice Guidance Note, April 2018
[20] https://www.ifpri.org/project/weai

- Collective action: # women and # men reporting that they could work collectively with others in community to achieve a common goal.

Decision-making: The skills, confidence and abilities of women and men to make productive decisions in farming. Sub-indicator:

- Input in productive decision-making: # women and # men who report they are equally able to input into productive decisions.

Control of economic assets: Attitudes held by women and men around women's access to and control over economic assets. It is measured by 2 sub-indicators:

- Control of economic assets: # women and # men who own or control productive asset
- Gender equitable attitudes: # women and # men who demonstrate gender equitable attitudes to control of economic assets.

Methodology

Calculating the Women's Empowerment Score

Each of the domains of change are weighted equally, meaning that each is worth one-third. Respondents' answers to the sub-indicators will generate a score that can be used as an indication of their level of empowerment.
Calculation:
Women's Empowerment = (Leadership 1 + Leadership 2 + Leadership 3) + ((Decision-Making) x 3) + ((Control of Financial Assets 1 + Control of Financial Assets 2) x 1.5)

Calculating a Gender Parity Score

Because questions are posed to the Farmer and his/her spouse, users can also calculate a Gender Parity score alongside a Women's Empowerment score. To calculate a Gender Parity Score, users may calculate the difference between averaged women's empowerment scores and averaged men's empowerment scores.

Aggregation Guidance

When aggregating data for the gender indicator, there are a few steps for each sub-indicator that need to be followed before inputting data into the analytical framework. Step-by-step guidance has been developed on the aggregation method, achievement parameters, and inadequacy cut-off.

15. FREQUENCY OF FATALITIES AND NON-FATALITIES ON THE FARM BY GENDER (PERCENTAGE)

This indicator tracks the number of fatalities and non-fatalities occurring on farm. Worker health and safety refers to the principle that workers should be protected from sickness, disease and injury arising from their employment. In the case of cotton and coffee production, a specific type of non-fatalities that deserve close monitoring are acute and chronic effect of pesticide exposure.

Dimension	Social
Area	Farmers and workers safety
Unit	% of fatalities and non-fatal injuries in the reference group
Relevance	All farms, aggregation at higher levels
Target	0% fatalities – Decrease in non-fatalities
Data points	• # of farmers and workers on the farm in the last 12 months • # of fatal accidents on the farm in the last 12 months • # of non-fatal injuries requiring 2+ days of lost time
Data collection	Yearly
Reporting	Yearly
Data sources	Administrative records, hospital records, farmers' interviews
SDG reference	9.3 Mortality rate attributed to unintentional poisoning 8.8.1 Frequency rates of fatal and non-fatal occupational injuries, by sex and migrant status

DEFINITIONS

Occupational injury is defined as any personal injury, disease or death resulting from an occupational accident. An occupational injury is different from an occupational disease, which comes as a result of an exposure over a period of time to risk factors linked to the work activity. Diseases are included only in cases where the disease arose as a direct result of an accident.

The ILO's Safety and Health in Agriculture Convention, 2001 regulates specific risks to workers in the agricultural sector, relating for example to machinery safety and ergonomics, handling and transport of materials, sound management of chemicals, animal handling, protection against biological risks, and welfare and accommodation facilities.
ILO Convention 155 on Occupational Safety and Health

METHODOLOGY

The Fatal OR non-fatal occupational injury rate can be calculated separately using the following formula:

$$= \frac{\text{Number of fatal OR non-fatal occupational injuries in the reference group}}{\text{Number of farmers and workers in the reference group}} \times 100$$

Occupational injuries are often underreported, which means that occupational injuries statistics from administrative records or registry systems may be less than comprehensive.

A self-monitoring methodology for acute pesticide poisoning among farmers has been developed by the FAO, which can be adapted to other farming situations.

REFERENCES

- Official SDG Metadata:
https://unstats.un.org/sdgs/metadata/files/Metadata-08-08-01.pdf
- Internationally agreed methodology and guidelines:
http://www.ilo.org/wcmsp5/groups/public/---dgreports/---stat/documents/publication/wcms_223121.pdf

Annex 1. List of sustainability initiatives reviewed

List of sustainability initiatives reviewed to identify the sustainability areas and sub-areas (indicators were drawn from the initiatives in bold characters:

1. **4C Association***
2. **Better Cotton Initiative (BCI)**
3. Committee on Sustainability Assessment (COSA)
4. **Cotton Connect / REEL code**
5. Cotton LEADS
6. **Cotton Made in Africa (CmiA)**
7. Fairtrade Foundation (Certified Cotton Mark) and Fairtrade Coffee/Fairtrade Cotton Sourcing Program™
8. **Fairtrade Standard for Small scale Producer Organizations**
9. **Global Coffee Platform/ Coffee Data Standard**
10. Global OrganicTextile Standard (GOTS)
11. HERproject™ - empowered women
12. **IFOAM Organic 3.0**
13. **ISEAL Common Core Indicators**
14. Living Income Community of Practice
15. **My Best Management Practices (MyBMP)**
16. Organic Cotton Accelerator
17. Organimark
18. **Rainforest Alliance – UTZ**
19. Responsible Brazilian Cotton (ABR)
20. Responsible Sourcing Network (RSN)'s YESS (Yarn Ethically and Sustainably Sourced) Cotton Lint Standard
21. Sedex and Sustainable Agriculture Initiative (SAI) Collaboration
22. **ICAC SEEP Expert Panel**
23. Sustainable Agriculture Network (SAN) project on forced labour alignment
24. **Sustainable Development Goals (SDGs)**
25. Sustainable Coffee Challenge (SCC)
26. Textile Exchange - Organic Content Standards (OCS)
27. World Fair Trade Organization (Asia)

Annex 2. Indicators Matrix and guidance documents

See Excel file with detailed information on data collection for each indicator.
Separate tabs included with data entry forms and other information for indicators #1, 2, 5, 7.

Additional documents for indicators #1, #3 and #14 will be annexed:

- Indicator #1: List of HHPs reported to be used on cotton and coffee production.
- Indicator #3: Water Crop Productivity methodology & survey template shared by CRDC as an example for Large Farm contexts.
- Indicator #14: Full methodology and tools to measure Women’s Empowerment.