Delta Framework

Sustainability Indicators

better cotton

GLOBAL COFFEE PLATFORM for a sustainable coffee world

INTERNATIONAL COTTON ADVISORY COMMITTEE

INTERNATIONAL COFFEE ORGANIZATION

Delta Framework

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The Delta Framework is the result of a 3-year consultation process that started in 2019 and engaged sustainability standards, retailers, donors, research institutes, national committees and international organisations from the agricultural sector.

In addition to the project partners[1], the stakeholders who have substantially contributed to the development of the indicators set through workshops, webinars, on-line surveys, field pilots and one-to-one calls include: the members of the Cotton 2040 platform[2], the SEEP members representing the Government of ten countries and the European Union, the Australian Sustainability Working Group, Cotton Incorporated (Cotton Inc), the ISEAL Secretariat and some ISEAL members such as Rainforest Alliance.

Several technical experts have been consulted for methodological guidance on specific indicators and tools: the FAO Global Soil Partnership for the soil indicator, the Australian Cotton Research Institute for the water metrics, the Cool Farm Alliance for the GHG emissions calculations using Cool Farm Tool, Global Forest Watch for the forest cover changes using the GFW Pro tool, and CARE International for the Women Empowerment indicator.

Cover photo: Farm-worker, Shahida, in Rahim Yar Khan, Punjab, Pakistan 2019.

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1 The four Delta Project partners are: Better Cotton, the Global Coffee Platform (GCP), the International Coffee Organisation (ICO), and the International Cotton Advisory Committee (ICAC).

2 The members of the Cotton 2040 Impacts Alignment Workstream include Better Cotton; Cotton Australia (for MyBMP); Cotton Made in Africa; the Cotton Research and Development Corporation (CRDC); Fairtrade; Textile Exchange; Cotton Connect, and the Organic Cotton Accelerator.

Contents

Acronyms

CO_2e	Carbon Dioxide Equivalent
ETc	Crop Evapotranspiration
ETL	Environmental Toxic Load
FAO	Food and Agriculture Organization of the United Nations
GBE	Green Bean Equivalent
GCP	Global Coffee Platform
GHGs	Greenhouse Gas Emissions
GHS	Globally Harmonised System of Classification and Labelling of Chemicals
GFW Pro	Global Forest Watch Pro
GLOSOLAN	Global Soil Laboratory Network
HHPs	Highly Hazardous Pesticides
ICAC	International Cotton Advisory Committee
ICO	International Coffee Organisation
IPM	Integrated Pest Management
IPPC	Intergovernmental Panel on Climate Change
MEL	Monitoring, Evaluation & Learning
NUE	Nitrogen Use Efficiency
OECD	Organization for Economic Co-operation and Development
SDGs	Sustainable Development Goals
SEEP	Expert Panel on the Social, Environmental and Economic Performance of Cotton
SOC	Soil Organic Carbon
SOM	Soil Organic Matter
SOPs	Standard Operating Procedures
TLI	Toxic Load Indicator
UNFCCC	United Nations Framework Convention on Climate Change
VSS	Voluntary Sustainability Standards
WHO	World Health Organization
WP	Water Productivity

Introduction

The Delta Framework aims to align sustainability monitoring and reporting within and across the cotton and coffee sectors. It provides a common set of indicators to measure and communicate sustainability improvements.

This framework builds on the work already undertaken by several commodity platforms and initiatives to define and harmonise 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)[3].

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

Finally, the framework has a strong alignment with the Sustainable Development Goals (SDGs) to promote the adoption of a common language and holistic approach to global sustainable agriculture.

3 SEEP is an expert panel of the International Cotton Advisory Committee (ICAC) established in 2006: https://www.icac.org/CommitteesandNetworks/

Scope of the framework

The Delta Framework is intended to apply worldwide to any cotton and coffee farm, with the potential to be expanded to other agricultural commodities over time. The scope is the farm, with the single exception of the greenhouse gas emissions indicator which also includes ginning in the estimation of the emissions per cotton lint.

Some of the environmental and social impacts are, however, better examined at a scale beyond the farm. For looking at these impacts, data can, and often will need, to be aggregated to a higher level to be more meaningful. Where possible, the Delta Framework recommends using area-wide geospatial tools such as Global Forest Watch Pro (GFW Pro) to monitor land use changes and country risk maps for child labour and forced labour.

The Delta Framework is relevant to all farms, including family farms and small-scale holdings managed and operated by a family and predominantly reliant on family labour. The term "farm" applies to all types of agricultural holdings, except for hobby farms[4].

"The **farm** is an economic unit of agricultural production under single management comprising all livestock kept and all land used fully or partly for agricultural production purposes, without regard to title, legal form, or size. Single management may be exercised by an individual or household, jointly by two or more individuals or households, by a clan or tribe, or by a juridical person such as a corporation, cooperative or government agency"[5].

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: www.fao.org/3/I8809EN/i8809en.pdf

5 A System of Integrated Agricultural Censuses and Surveys. Volume 1: World Programme for the Census of Agriculture 2010. FAO Statistical Development Series 11., FAO, Rome, 2005.

Intended uses

The intended uses of the Delta Framework include:

- Integration in the Monitoring, Evaluation & Learning (MEL) Systems of Voluntary Sustainability Standards (VSS) working in agriculture;
- National reporting on the commitments set by the SDGs and the ratification of relevant international conventions on chemicals, climate change, biodiversity, gender equality/women's empowerment, and labour rights;
- Evidence-based recommendations to streamline sustainability in agricultural policies;
- Upgrading of extension services to support continuous improvement at farm level;
- Farm management plans to ensure an environmentally and financially sustainable agricultural operation;
- Transparent communication with consumers on the actual benefits of goods produced more sustainably;
- Identification of business opportunities leveraging sustainable value chains.

In order to support users of the Delta Framework, the Delta Project team developed a set of guiding documents to integrate the indicators into existing monitoring systems, to collect and analyse data, and to properly communicate sustainability improvements.

These guidelines are available on the Delta Project website and include:

1. **Integrating new performance indicators into sustainability systems: practical considerations.** This document includes considerations and a set of guiding questions designed to support the inclusion of the indicators in the Monitoring, Evaluation and Learning (MEL) systems of Voluntary Sustainability Standards (VSS) and other organisations;
2. **Basic guidance for obtaining informed consent for the Delta Framework indicators data collection.** This document guides the incorporation of informed consent for the Delta Framework indicators data collection into existing organisational data strategy and policies;
3. **Description of a common data model for the Delta Framework indicators.** This document supports the implementation of common data models to facilitate future data aggregation and collective reporting;
4. **Principles to define and communicate sustainability performance in the agricultural commodity sector.** This document directs public and private sector stakeholders on deriving sustainability information and messages on the production of agricultural commodities from the data.
5. **Data aggregation and reporting tool for the Delta Indicators.** This tool aims to support national commodity associations and other relevant public bodies to aggregate producer level data using the Delta indicators to assess the sustainability performance of the commodity's production at country level.

Sustainability areas and goals

The fifteen sustainability impact priorities for coffee and cotton production underpinning the Delta Framework (sustainability impact sub-areas reported in bold in Table 1) were largely drawn from existing frameworks[6], and in particular from the SEEP Guidance Framework, the Coffee Data Standard, and nine other commodity sustainability standards and initiatives (Annex 1- List of sustainability initiatives reviewed).

These sustainability priorities directly link to several SDGs targets and more specifically to those under SDGs 1 (no poverty), 2 (zero hunger), 3 (good health and well-being), 5 (gender equality), 6 (clean 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).

Table 1. Key Sustainability impact priorities underpinning the Delta Framework and their relevance to SDGs

Sustainability Pillars	**Key sustainability impact areas** drawn from existing frameworks[6]	**Sustainability impact sub-areas** (in bold sub-areas underpinning the Delta Framework)	**Link to SDGs**
Environment	Pest and pesticide management	**Pesticide management**	3, 6, 12, 13, 15
		Pesticide risk	
		Pest management	
	Water management	Water quality	
		Water use	
	Soil management	**Soil health**	
		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	

6 A detailed account of the process followed to identify and validate sustainability priority areas is provided in the Delta Framework Development Report available on the Delta Project Website.

Sustainability Pillars	**Key sustainability impact areas** drawn from existing frameworks[6]	**Sustainability impact sub-areas** (in bold sub-areas underpinning the Delta Framework)	Link to SDGs
Economic	Economic viability	**Income**	1, 10
		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, sanitation	
Social	Decent work	**Wages**	2, 5, 8, 10
		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	
	Labour rights	No discrimination	
		Democratic organisations	
		Freedom of association	
	Food security	Access to food	

Drawing from the priority areas, cotton stakeholders have formulated nine shared sustainability goals for the sector and eight sustainable cotton standards, programmes, and codes committed to take practical steps towards aligning with the Delta Framework Indicators under a Memorandum of Understanding (MoU) signed in September 2020[7].

7 The MoU is available at: https://www.forumforthefuture.org/Handlers/Download.ashx?IDMF=9a70b369-7295-4f3e-b60d-18f8a9c36f42

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Table 2. Shared sustainability goals for the cotton sector

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 alleviate poverty	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

The Delta Sustainability Indicators

The Delta Framework comprises a core set of **15 farm-level, outcome/impact indicators across the social, economic, and environmental dimensions of sustainability**.

These indicators were selected over the 200 reviewed for their global relevance, usefulness and feasibility in monitoring progress towards sustainable agricultural commodities:

- **Relevance**: progress towards goals and credibility
- **Usefulness**: link to global commitments, comparability and possibility to aggregate results, response to stakeholders' needs
- **Feasibility**: ease of data collection and costs.

In 2020 and 2021, the indicators were piloted in South Africa, India, China, the USA, Brazil and Peru for cotton, and in Vietnam for coffee in over 1,000 farms collectively[8]. The learnings generated during the data collection were critical to the refinement of the indicator methodologies as they are presented in this version of the Delta Framework. The methodological limitations that could not be adequately addressed are acknowledged in the description of the indicators.

DELTA SUSTAINABILITY INDICATORS

1. Use of Highly Hazardous Pesticides (HHPs)
2. Pesticide risk indicator
3. Water management (in irrigated farms)
   - 3.1 Water extracted for irrigation
   - 3.2 Irrigation Efficiency
   - 3.3 Water Productivity (WP)
4. Topsoil carbon content
5. Quantity of fertilizers used by type and Nitrogen Use Efficiency (NUE)
6. Forest, wetland and grassland converted for crop production
7. Greenhouse Gas Emissions (GHGs)
8. Yield (average)
9. Gross margin from crop production (Living income in future)
10. Price (at farmgate)

8 The organisations that participated in the field pilots are: Cotton Connect, Cotton Incorporated, Better Cotton, Fairtrade Foundation, GCP, the Organic Cotton Accelerator and Textile Exchange.

11. Proportion of workers earning a legal minimum wage (or above) by sex and by age
12. Incidence of the child labour
13. Incidence of forced labour
14. Women's Empowerment
15. Number of fatalities and non-fatalities on the farm by sex

Considering the interdependences between the three sustainability dimensions, the set of common indicators needs to be seen as a whole, while the relative priority of each indicator may vary from country to country. 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 instance, soil erosion might in some farming contexts be the primary cause for the deterioration of soil health and the loss of soil organic content.

The Delta Framework focuses on impact and outcome indicators to track progress towards sustainability in agriculture. This is aligned with the SDG 4.2.1 guidance which 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."** The monitoring of farm practices is however useful and recommended for several of the environmental indicators to better interpret changes at the outcome/impact level, e.g., good soil management practices are critical to explain variations over time in the soil organic content, and implementation of an Integrated Pest Management Plan (IPM) is critical to reduce pesticide use and risk.

Description of the indicators

1. USE OF HIGHLY HAZARDOUS PESTICIDES (HHPs)

Phasing out the use of Highly Hazardous Pesticides (HHPs) is a shared goal of sustainability initiatives. This indicator measures the use of HHPs, such as aldicarb, benomyl, carbendazim, carbofuran, dicofol, endosulfan, etoprophos, lindane, methamidophos, monocrotophos, paraquat, parathion-methyl, phorate, etc., in cotton and coffee production. HHPs 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 unintentional exposure to pesticides is common.

Dimension	Environmental and social
Area(s)	Pest and pesticide management
Unit	Kg active ingredient (a.i.) of Highly Hazardous Pesticides (HHPs) applied per ha of harvested land
Relevance	All except for 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 HHPs' active ingredients applied to the crop • Harvested area in ha • Time-bound plan with progressive, phase-out milestones
Data collection	Yearly
Reporting	Yearly
Data sources	Farm records, farmer interviews. Farm level data can be crosschecked with import and pesticide industry records, with cotton companies data and with extension officers
SDG reference	2.4.1: Use of Highly or Extremely Hazardous or illegal pesticides by the agricultural holding (Y/N)

DEFINITIONS

Definitions from the FAO/WHO International Code of Conduct on Pesticide Management, 2014

Active ingredient is the part of the product that provides the pesticidal action.

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)[9] 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 reference 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 HHPs 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);

9 The JMPM combines the FAO Panel of Experts on Pesticide Management and the WHO Panel of Experts on Vector Biology and Control. The JMPM advises on matters pertaining to pesticide regulation, management and use, and alerts to new developments, problems or issues that otherwise merit attention.

- 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);
- 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.

During the phase out period, results can be reported in the reduction of kgs of each listed active ingredient used per ha of harvested land. Results need to be reported in relation to the milestones set in the time-bound phasing out plan. 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 farmers reporting phasing out of listed HHPs. It should be noted that HHPs are not expected to be used in a sustainable system, therefore there is no scope to report their use by volume of production, which is a measure of use efficiency.

LIMITATIONS

- The list of HHPs (active ingredients) is not exhaustive and it requires regular updates;
- Identifying HHPs requires a certain level of technical expertise which is not always available within sustainability programmes and VSS.

KEY REFERENCE MATERIAL

- FAO/ WHO International Code of Conduct on Pesticide Management, 2014
- FAO/WHO Guidelines on Highly Hazardous Pesticides

2. PESTICIDE RISK INDICATOR

Sustainable farming systems embrace the key principles of ecological pest management. 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.

The existence of an Integrated Pest Management (IPM) plan is a pre-requisite to drive a reduction in pesticide use and risk. Pesticide use can be reduced by the 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.

Dimension	Environmental and social
Area	Pest and pesticide management
Unit	Specific model scores/ha, e.g., Toxic Load Indicator or Environmental Toxic Load scores/ha
Relevance	All farms except from farms under organic management
Target	Continuous reduction of risk 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

METHODOLOGICAL NOTES

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 instance, 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 an assessment category and be able to adequately assess the risks that the use of neonicotinoids poses on bees, beneficial insects and on insectivorous bird populations.

The models currently used in the European context for pesticide registration have gained an international reputation and can all be used for the purpose of this framework. 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 is 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, water fleas (Daphnia species), fish, birds and honey bees.

The Toxic Load Indicator (TLI) is a qualitative indicator for the hazards caused 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, water fleas (Daphnia species), arthropods, fish and birds. It also includes an acute and chronic health hazard category.

KEY REFERENCE MATERIAL

- Selection of Pesticide Risk Indicators: Guidance for Policy Makers, OECD, 2016.

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3. WATER MANAGEMENT (IN IRRIGATED FARMS)

3.1 Water extracted for irrigation

3.2 Irrigation Efficiency

3.3 Water Productivity

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 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).

Dimension	Environmental
Area(s)	Water management
Unit	3.1 Water extracted for irrigation – water extracted for irrigation (blue water) expressed as ML[10] 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 (WP) – expressed as yield (kilograms of cotton lint or Green Bean Equivalent (GBE)) per cubic metre of water consumed per hectare of harvested land (kg/m3)
Relevance	All farms
Target	Locally specific – Increase efficiency over time
Data points	• Water extracted for irrigation • Beneficially consumed water • Rainfall or effective rainfall • Cotton lint or GBE harvested • Evapotranspiration (ETc) • Soil Moisture • (Irrigated) harvested area
Data collection	Yearly
Reporting	Yearly

10 Megalitre is equivalent 1000 cubic meter

Data sources	Farm records, rainfall records from official statistic or local rain gauge, soil moisture field measurement, ETc reference values from published articles or dataset like IrriSAT
SDG reference	6.4.1: Change in water-use efficiency over time. The SDG indicator measures the value added per water withdrawn, expressed in USD/m3 over time of a given major sector (showing the trend in water use efficiency)

DEFINITIONS

Beneficially consumed water. This is a measure of the water actually consumed by the crop and is calculated as evapotranspiration (ETc) of the crop (as defined by FAO 56)[11].

Effective rainfall: Water that actually infiltrates to the root zone.

Evapotranspiration. The combination of two separate processes whereby water is lost on the one hand from the soil surface by evaporation and on the other hand from the crop by transpiration is referred to as evapotranspiration (ETc).

Rainfall (Green water). Local seasonal rainfall recorded during the growing season.

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.

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.

Sum of all the volumes of water extracted or diverted in one season to grow the crop

11 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.

3.2 Irrigation Efficiency

Irrigation Efficiency is the ratio of water actually required for irrigation over the total water diverted or extracted[12] (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).

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

3.3 Water Productivity (WP)

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 (**WPlint/ET**) and to the total water available to grow the crop (**WPlint/I+R**).

Water Productivity in terms of water beneficially consumed (WPlint/ET) is the generally favoured definition of Water Productivity internationally[13]. 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'[14]. 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[15]. For this reason we also recommend the use of the total input Water Productivity.

$$\text{WPlint/ET} = \frac{\text{Cotton yield}^{16} \text{ (tonnes cotton lint/ha harvested land) OR GBE}}{\text{ETc}}$$

$$\text{WPlint/I+R} = \frac{\text{Cotton yield}^{17} \text{ (tonnes cotton lint/ha harvested land) OR GBE}}{\text{Water for irrigation + rainfall}}$$

12 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

13 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

14 **ibid**

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

16 Yield calculated as indicated under Indicator 8

17 Yield calculated as indicated under Indicator 8

These formulas do not account for the biomass produced in marketable co-products, for example in cotton seed. This is particularly important when extrapolating yield/m3 measures of Water Productivity to USD/m3 measure of economic return per unit of water (as indicated under the SDG 6.4.1). 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

Following the feedback received from the project's pilot, a simplified methodology for the collection of rainfall and soil moisture data has been developed. It should however 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 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.

Replacing total rain with effective rain in tropical, monsoon climatic zones
Further to point 1. from above, analysis of datasets from pilot trials in India found that effective rainfall needs to be incorporated instead of using total rainfall. Rainfall during monsoonal months, when totals were extremely high, would also need be omitted or adjusted for the Irrigation Efficiency metric to be resolved.

Total rainfall can be converted to effective rain by multiplying by an established rainfall efficiency coefficient. Applying a coefficient to large datasets on small timeframes is complex as the soil type, slope, groundcover, rainfall intensity, soil moisture content all influence the amount of rainfall that infiltrates into the soil profile and rootzone of the plant. More detailed data on shorter timeframe (daily) would be required to obtain a more accurate estimate of effective rainfall.

Where detailed datasets are not available, a 'rule of thumb' coefficient range of 0.75-0.85 may be applied to estimate effective rainfall. Noting that in drier months, the soil profile is more likely to be drier and a greater proportion of rainfall is likely to infiltrate, which is better represented by a higher coefficient (i.e., towards the 0.85 end). Conversely, during the wetter months, a coefficient lower down the scale could be used. Methods to estimate effective rainfall coefficients can be found in the reference material.

In some monsoonal months, the rainfall and the crop water use could be excluded from the calculation of Irrigation Efficiency as the metric will not resolve given the monthly rainfall exceeds the total crop water use for the whole season. Alternatively, the rainfall amount could be set to equal the crop water demand. It is highly unlikely any irrigation occurs during these monsoonal months, so excluding them or setting the rainfall to equal the crop water use is appropriate. A dynamic approach is needed to apply this metric as heavy rainfall can be experienced in different months from the previous year.

The method of applying an effective rainfall coefficient should also be applied to the Water Productivity metric. During the heavy rainfall monsoonal months, the total rainfall should be included but set equal to the crop water demand. During these heavy rainfall months, significant amounts of water will make its way into the root zone and then be lost as deep drainage and therefore not be effective, however the small amounts of water used by the crop should still be included.

Reporting Units. Care is also necessary with the units for reporting indicators. Typical rainfall and ET are expressed in millimetres (per m2), while irrigation water is reported in cubic metres (per m2) or ML (per ha). Rainfall and ET need to be converted to the same units as irrigation water (m3), when calculating Total input water, Irrigation Efficiency and Water Productivity. To convert from rainfall and ET from mm to m3 divide by 1000; to convert irrigation water from ML/ha to m3 divide by 10. For example, 150 mm of rainfall is equivalent to 0.150 m3 (and 1.50 ML/ha).

Beneficially consumed water or Crop water use is measured as the cumulative evapotranspiration (ETc) (mm) of the crop during the growing season[18]. 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 ETc is calculated following FAO 56[19], as the daily reference evapotranspiration (ET0) multiplied by the crop factor (Kc).

While ETo can be calculated with the FAO56 method[20], it may also be sourced from published values. Kc can be calculated with reference to remote sensing software or applications. A worked example of obtaining ETo and Kc values, and how to use these to calculate cumulative ETc is given in Annex 4.

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 the efficiency of the crop to convert water into yield.

18 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.

19 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.

20 ibid

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 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 season, 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 a 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 Irrigation Efficiency and Water Productivity without the soil moisture component can be used. These are referred as partial Irrigation Efficiency and Water Productivity, 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 shall be explored when the Delta Framework will be revised.

LIMITATIONS

- Notwithstanding the relevance of these water metrics to all irrigated farms, concerns remain on their feasibility and cost in small-scale farming for both cotton and coffee where water use, and soil moisture records are mostly not available;
- The formula to calculate Irrigation Efficiency and Water Productivity are not well adjusted to tropical, monsoon zones.

KEY REFERENCE MATERIAL

- Benchmarking Water Productivity of Australian Cotton, 2019
  - www.youtube.com/playlist?list=PL4zlvcUKKUmW1M8WN854xdpBkwg1Fpr4q
  - www.cottoninfo.com.au/podcasts/podcast-4-water-benchmarking-study
- Gravimetric water content in the "Soil testing methods manual", FAO 2020
- Effective Rainfall Calculation Methods for Field Crops: An Overview, Analysis and New Formulation.

4. TOPSOIL CARBON CONTENT

This indicator measures the Soil Organic Carbon (SOC), which is the main component of the Soil Organic Matter (SOM), in the top layer of the soil (0 - 10/30 cm) over time. SOM is increasingly being recognised for its contribution to nutrient cycling, water retention, biological function, and optimising crop growth. It is the foundation of soil health, which is the ability of the soil to sustain the productivity, diversity, and environmental services of terrestrial ecosystems. SOM is however hard to measure directly, and it is therefore generally estimated based on SOC values. Sustainable agricultural systems 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. 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.

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 (SOC) • Soil bulk density • Harvested area in ha
Data collection	Yearly visual or spectroscopic assessments and laboratory tests every 5 years
Reporting	5 years
Data sources	Visual or spectrometric assessments, laboratory tests results
SDG reference	15.3.1: Proportion of land that is degraded over total land area

DEFINITIONS

Definitions from the Soil Organic Carbon, the hidden potential, FAO, 2017

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 carbon by mass.

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, ensures sufficient aeration and water infiltration to support plant growth.

METHODOLOGICAL NOTES

A combination of **yearly visual or spectrometric assessments of soil colour and biological activity** with periodic **laboratory topsoil testing** is recommended to monitor SOC.

Visual or spectrometric assessment: The simplest method for visual assessment and colour determination is the Munsell Notation System. The Munsell soil-colour charts contain 238 standardised colours arranged in seven charts and encoded in the Munsell system. Each chart uses three coordinates well correlated with the visual colour attributes: hue, value and chroma. The soil testing methods manual provides guidance on assessing soil colour with farmers (see references). Visual assessment however requires a significant field experience to avoid the human error associated with the interpretation and/or perception of the colour of the sample. A more accurate but expensive method is the use of a portable spectrophotometer to determine carbon in soils by direct measurement of sample spectra in the near-infrared spectral region.

Soil sampling. The soil should be sampled prior to any organic or inorganic fertilization and to sowing of annual crops. The laboratory selected for the soil test will provide a detailed protocol to collect and prepare the soil samples. In general, sample should be taken from the first 0-15 to 20 centimetres of soil with a trowel, avoiding soil disturbances as much as possible. Each sample should consist of sub-samples taken from 5 to 20 locations within the sampling area following a defined shape such as an S, or X, or E or W (the number of sub-samples and the sampling shape will depend on the size of the field and the crop grown). As a general rule, sampling in spots where conditions are different from the rest of the field should be avoided (e.g., fence lines, former manure piles). 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. Soil samples should be taken from the same field areas every year to be comparable.

A stepwise approach is proposed to carry out the visual assessment:

Step 1 – Prepare the sample for the colour reading. The sample should be moist, not wet or dry;

Step 2 – 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. It is however advisable that researchers or expert technicians accompany farmers in this exercise to develop their soil colour assessment skills.

Step 3 – Estimate the organic carbon content based on the Munsell soil colour value using the values reported in the table below;

Step 4 – 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 a long time, the soil sample used for the visual assessment need to be preserved or a new sample collected to "re-calibrate" the visual assessment;

Step 5 – Compare readings with previous values to estimate if there has been an increase or decrease in soil organic content by looking at the change in colour.

Table 3: Estimation of Organic Matter Content (SOC) based on Munsell soil colour[21].

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 Framework will align with the Standard Operating Procedures (SOPs) proposed by GLOSOLAN to harmonize organic and total carbon measures. 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 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 more prevalent.

Most commercial soil tests report SOC 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).

21 Table extracted from the GUIDELINES FOR SOIL DESCRIPTION, FAO. 2006, pg. 46.

Example of conversion:
1.25% soil organic carbon = 1.25 gr soil organic carbon per 100 gr soil
= 12.5 gr carbon per kg soil = 12,500 gr carbon per metric tonnes soil.

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 new management practices such as reduced or 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/cm3) = Dry soil weight (g) / Soil volume (cm3). For a step-wise guide to measure soil bulk density refer to the factsheet on Bulk Density.

Adjusting SOC 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.

Reporting units. SOC 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.

It should also be noted that changes in SOC generally occur over many years, and it is often difficult to appreciate small variations. **SOC stock changes** however are a key factor in GHG emission accounting. Guidance to estimate country SOC stock changes is provided in the IPCC 2019 GHG Inventory Guidelines for SOC estimation. Depending on the available data and resources in a given country, the IPCC GHG Inventory Guidelines define three levels of "Tier" from the most basic method (Tier 1) to the most complex and accurate (Tier 3). All the three tiers factor in data on land use and soil management practices (managing crop residues and reducing tillage). The use and monitoring of good management practices to improve soil health and productivity is recommended, including:

- Use of cover crops and/or perennials in crop rotations;
- Implementing crop rotations with more crops;
- Effective (e.g., appropriate application rate, time and method) use of organic amendments, such as animal manure, compost, digestates, biochar;

- Balanced fertilizer applications with appropriate and judicious fertilizer application methods, types, rates and timing;
- Managing crop residues: using forage by grazing rather than harvesting, applying mulches or providing the soil to give permanent cover;
- Reducing tillage events and intensity and/or adopting new residue management techniques, minimum or no-tillage;
- Landform management modifications such as those implemented for erosion control (e.g., terraces), surface water management, and drainage/ flood control.

LIMITATIONS

- Accredited laboratories for soil testing are limited in some countries and soil testing can be expensive;
- The visual determination of soil colour with Munsell charts requires extensive field experience.

KEY REFERENCE MATERIAL

- Munsell Notation System
- Practical guidance to read soil colour Munsell charts
- Soil testing methods manual. Soil Doctors Global Programme. A farmer-to-farmer training programme. FAO, 2020
- Soil Organic Carbon, the hidden potential, FAO, 2017
- Standard Operating Procedures (SOPs) for Soil Organic Content., FAO, 2020
- Guidelines for soil description, FAO, 2006
- Factsheet on Soil Bulk Density
- Global Soil Partnership Website
- Voluntary Guidelines for Sustainable Soil Management FAO, 2017

5. QUANTITY OF FERTILIZER USED BY TYPE AND NITROGEN USE EFFICIENCY

This indicator requires 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. It is a relevant measure for improving productivity and for pollution prevention strategies. This indicator does not include organic fertilizers.

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) Optimisation of NPK use Reduction of environmental risks associated with fertilizer use
Data points	• Kg of fertilizer products used • Fertilizer conversion factors for: - Nutrient nitrogen N kg / ha - Nutrient phosphate P_2O_5 kg /ha - Nutrient potash K_2O kg / ha • Harvested area in ha • Yield • Crop residue management practices
Data collection	Yearly
Reporting	Yearly
Data sources	NPK fertilizer applications/purchases records
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**.

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.

In addition to fertilizer use, **Nitrogen Use Efficiency** (NUE) is a useful metric to understand the relationships between the total nitrogen input compared to the nitrogen output and optimize the fertilization regime. The simplest way to calculate NUE is in kgs of total nitrogen applied per output (Kgs of lint cotton or GBE harvested) or per area (ha of lint cotton harvested). This implies that within a crop rotation the soil available nitrogen is a constant. The NUE, although it does not provide information on the other soil nutrients, is a very useful metric for farm productivity and profitability.Nitrogen Use Efficiency can also be calculated as lint yield (kg/ ha) divided by the total amount of N applied.

LIMITATIONS

- The indicator does not account for organic fertilizer and estimating the amount of nutrients in various organic fertilizers (e.g., manure) is complex.

KEY REFERENCE MATERIAL

- International Fertilizer Association

6. FOREST, WETLAND AND GRASSLAND CONVERTED FOR CROP 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. The degradation and conversion of forests to alternative land uses, such as agriculture, is one of the leading causes of biodiversity loss. 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 the 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[22] • Converted land geolocation data
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

Definitions from the Forest Resource Assessment, FAO, 2020

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 activity, and the ecological processes are not significantly disturbed.

Definitions from 2019 Refinement of the 2016 IPCC Guidelines for National Greenhouse Gas Inventories

Wetland: This category includes land that is covered or saturated by water for all or part of the year (e.g., peatland) and that does not fall into the forest land, cropland, grassland, or settlements categories. The

22 The 5-year reference period is in alignment with the Coffee Data Standard

category can be subdivided into managed and unmanaged according to national definitions. Wetlands occur over all climate zones and include reservoirs and other constructed waterbodies (e.g., agriculture and aquaculture ponds, canals and ditches and wetlands constructed for wastewater treatment) as managed sub-divisions. Managed wetlands may also include peatlands, riparian wetlands, forested swamps, marshes, playas, pans, salt lakes, brackish wetlands, salinas, and sabkhas, in addition to coastal wetlands, including mangroves, saltmarshes, tidal marshes and seagrass. Unmanaged wetlands include natural rivers, lakes and ponds and any wetlands that have not been directly modified by human activity based on the Managed Land Proxy.

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 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

Deforestation is assessed using geo-referenced risk maps. Some of the existing approaches in the agricultural sector relevant to commodity sector are described below.

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.

Rainforest Alliance has developed a deforestation risk tool to evaluate whether a farm is located within areas where deforestation has been detected from 2014 onwards and therefore there is a risk of further deforestation. The general methodology consists of 3 steps:

1. Mapping farm location using a combination of location points and polygons;
2. Creating a deforestation map and add the farm to the deforestation layer to identify if there has been a conversion of forest areas to agricultural production; and

3. Assign the deforestation risk based on the following criteria:
    - Percentage of overlapping within the deforested area
    - Total deforested areas. For big farms a farm size threshold is applied.

GFW Pro offers a forest change analysis that shows where tree cover loss occurred in a given location and highlights loss that occurred on some of the most sensitive forest areas in deforestation policies. It also offers a risk analysis that illustrates the risk that a commodity (cocoa, soy and palm oil as of now) is associated with deforestation at the global and regional level.

LIMITATIONS

- While the current application of GFW Pro is relevant to coffee, it has a limited applicability to cotton since the latter is rarely grown in tropical areas. Also, GWF Pro only identifies trees above 5 meters. On-going and future developments under the Land & Carbon lab project may see an expansion of the GWF Pro coverage to non-tropical and arid regions, including grasslands and wetlands;
- Accurate geolocation data of field/plots under annual crops is difficult to obtain especially in the case of small holder farmers;
- In some countries, where disputes on land ownership are frequent, this information may be sensitive to collect.

KEY REFERENCE MATERIAL

- Forest Resource Assessment, FAO, 2020

7. GREENHOUSE GAS EMISSIONS

This indicator is defined as the ratio between CO2 equivalent (CO2e) emissions from agricultural activities and the marketable biomass produced: e.g., cotton lint or 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/coffee production; when the reporting is calculated per cotton lint or GBE, the calculation shall also include the ginning process for cotton or wet/dry processing for coffee.

Dimension	Environmental
Area	Climate change
Unit	Kg CO2e / kg seed cotton or coffee cherries Kg CO2e / kg cotton lint or GBE
Relevance	All farms
Target	Carbon neutral Intermediate milestones (X% reduction by year XXXX) as defined by countries, organisations, or sustainability initiatives
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 • Land conversion • Tillage • Cover crops • Tree biomass
Data collection	Yearly
Reporting	3 years
Data sources	Farmers' interviews and secondary data
SDG reference	13.2.2: Total greenhouse gas emissions per year

Several tools have been developed to quantify on-farm greenhouse gas (GHG) emissions. The most important variables for GHG estimation are fertilizers and pesticides used, irrigation water used and irrigation system, cover cropping, use of residues and energy use. Three examples are reported below:

A user-friendly option for cotton and coffee is the Cool Farm Tool. The tool is suitable for farm-level estimates (emissions from cotton or coffee processing are not included) and is flexible in the definition of the assessment boundaries.

The Field to Market Alliance for Sustainable Agriculture has developed a tool called Fieldprint Platform, which includes GHG emissions. The Fieldprint Platform is based on national datasets and therefore relevant to cotton farming in USA. Australia has developed a specific GHG tool to calculate emissions from cotton production and ginning.

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). This tool focuses on crop emissions only.

Table 4: Comparison of the scope of three GHG emissions calculators

Cool Farm Tool	GeoFootprint	Fieldprint Calculator
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 US government assumptions regarding fuel use, such as the 22.3 pounds of CO2e 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.

LIMITATIONS

- All tools require a large number of data points to estimate GHG emissions;
- The tools need some adjustments to estimate emissions associated with organically grown crops (the Delta Project team is collaborating with the CFT developers to include a specific module on organic fertilizers and biopesticides).

KEY REFERENCE MATERIAL

- 2019 Refinement of the 2016 IPCC guidelines for National Greenhouse Gas Inventories.
- 2016 Guidelines for National Greenhouse Gas Inventories

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 coffee 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 area harvested (Cotton harvested area or Coffee productive land) • Conversion factors to lint and to GBE
Data collection	Yearly
Reporting	3-year average
Data sources	Farm cash records, farmer interviews
SDG reference	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 conversion 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 volume harvested requires local unit conversion to kgs. 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).

KEY REFERENCE MATERIAL

- ICAC Cotton Data Book, 2020 – Paid publication
- ICO conversion factors

9. GROSS MARGIN FROM CROP PRODUCTION (LIVING INCOME IN FUTURE)

Gross Margin (GM) is the average gross income from seed cotton or coffee minus the cost of production (variable costs). GM analysis represents the most widespread basis for farm planning of the next year's production, and it should be calculated for each crop that contributes to a farm's aggregate profit. In the context of this framework, however, the indicator refers specifically to the GM generated by the production of cotton or coffee as a measure of the profitability and economic viability of these commodities.

A more refined measure of the economic sustainability of farming is the living income, a concept that looks at the net annual income required for a household in a particular place to afford a decent standard of living for all members of that household. Although there is a variety of methodologies available or in development to calculate the living income, the data efforts required by these methodologies as of today are very significant. It is hoped that the living income indicator will be integrated in a future revision of the Delta Framework.

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

DEFINITIONS

Gross income. Gross income is the income generated through the selling of seed cotton (includes lint and seeds) or GBE at the farmgate price[23].

Variable costs are costs associated with the actual production. They vary as production output changes. Variable costs include: cost of inputs such as seeds, fertilizers, pesticides, water, cost of non-permanent labour, cost of fuel and energy, machinery replacement parts used and disposed of in the production cycle, financial costs (interest and fees) of loans taken for the crop cultivation (e.g. inputs) and maintenance of machinery charges.

23 The value of produce consumed or stored on farm from the reference harvest should be included in the gross income.

Fixed costs are costs that do not change with the production output and are not included in the calculation of gross margin. Fixed costs include the purchase of machinery, permanent labour, and depreciation.

METHODOLOGICAL NOTES

GM is the gross income less the variable costs incurred in producing the crop. GM is not the same as net profit because it does not include fixed or overhead costs such as amortization and depreciation, interest payments, rental rates, permanent labour, administrative costs, etc.

Gross Margin (GM) = Gross income or revenue /ha – Variable costs/ha.

Where:

Gross income or revenue = Yield x farmgate price
Variable costs = All costs that vary depending on the volume of crop produced

The International Monetary Fund (IMF) provides official exchange rates on a monthly basis to convert local currency into USD for selected countries.

The World Bank dataset provides official exchange rates and the DEC alternative conversion factor which is the underlying annual exchange rate used for the World Bank Atlas method. As a rule, it is the same as the official exchange rate reported in the IMF's International Financial Statistics (IFS), except where further refinements are made by World Bank staff when official exchange rates are deemed to be unreliable or unrepresentative of the effective exchange rate during a period. It is expressed in local currency units per US dollar.

LIMITATIONS

- The computation of GM requires basic financial transactions which are usually maintained in large commercial farms, but rarely 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;
- GM alone is not an exhaustive measure of the economic sustainability and wellbeing of the household. The living income is a more mature concept that put a strong emphasis on the idea of decency and earning enough income to live comfortably.

KEY REFERENCE MATERIAL

- Farm Management Tool: Gross Margin Budgeting, online presentation, FAO
- Living Income Community of Practice

10. PRICE (AT FARMGATE)

This indicator refers to the average price received per tonne of seed cotton or coffee (GBE). Price is an important measure of the economic health of the commodity sector. Price trends over time can provide, together with other economic variables, an insight into price stability, as well as the level of inflation or deflation.

Dimension	Economic
Area	Economic viability
Unit	Local currency and/or USD per tonne of seed cotton or coffee (GBE)
Relevance	All farms. Relevant to premium-based standards only.
Target	Price stability (tentative)
Data points	• Average price for the year • Total revenue • Total volume sold • Exchange rate
Data collection	Yearly
Reporting	3- year average
Data sources	Farm cash records, farmer interviews, ginning mills records (cotton), traders and buyers' records
SDG reference	1: No Poverty

METHODOLOGICAL NOTES

Average price per unit: If actual sale prices are available, the average price for the year should be calculated. Alternatively, a simplified approach involves dividing the total revenue received from cotton or coffee during the last production year by the volume sold.

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 the USA, Brazil, and Australia, values will be provided for lint and cotton seed and converted into seed cotton.

Conversion rates from local currency to USD can be accessed at the World Bank dataset and the International Monetary Fund (IMF).

DEFINITIONS

Farmgate price is in principle the price received by farmers for their produce at the location of the farm. Thus, the costs of transporting from the farm gate to the nearest market or first point of sale and market charges (if any) for selling the produce are, by definition, not included in the farm gate prices.

LIMITATIONS

Primary data on prices are often hard to obtain or unreliable. Secondary data sources are often required to obtain accurate prices.

KEY REFERENCE MATERIAL

Price statistics and Index Numbers of Agricultural Production and Prices. Chapter 4 Concept on price data, FAO online.

11. PROPORTION OF WORKERS EARNING A LEGAL MINIMUM WAGE (OR ABOVE) BY SEX AND BY AGE

This indicator provides information on the earnings that workers receive in exchange for their work, and therefore an indication of their purchasing power and living standards. Wages of all workers, including part-time and seasonal workers, should be equal to or above existing legal national minimum wages or sector agreements, whichever is higher.

The analysis of this indicator, together with the economic indicators, can illustrate the extent to which economic growth and labour productivity translate into gains for workers. Trends in employees' earnings over time bring to light improvements or deteriorations of working conditions. In addition, statistics on earnings disaggregated by sex can reveal the existence of eventual gender disparities in workers' retribution (gender gap pay). Although the SDG 8.5.1 monitors the average hourly earnings, the Delta Framework indicator focuses on the average daily earnings to preserve alignment with the Coffee Data Standard.

Dimension	Social
Area	Labour rights
Unit	Proportion (%) of workers earning a legal minimum wage (or above) over the total number of workers working on the farm by sex and age.
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	• # of hired (permanent and temporary) workers working on the farm in the reference period by sex • Total labour cost in the reference period per worker OR Daily wage rate paid to each worker • # of days worked in the reference period • National minimum wages and/or sector agreements • Currency conversion rates
Data collection	Yearly
Reporting	Yearly
Data sources	Work contracts, farmer interviews, farm workers interviews
SDG reference	8.5.1: Average hourly earnings of female and male employees, by occupation, age, and persons with disabilities

DEFINITIONS

Definitions from the ILO Minimum Wage Policy Guide

Minimum wages are the minimum amount of remuneration that an employer is required to pay wage earners for the work performed during a given period, which cannot be reduced by collective agreement or an individual contract.

Definitions adapted from Fairtrade Standard for Small-scale Producer Organisations

Workers: all workers including migrant, temporary, seasonal, sub-contracted and permanent workers. Workers are waged employees hired to work in the field. The term is restricted to personnel that can be unionised and therefore, middle and senior workers, as well as other professionals are generally not considered workers.

Migrant workers: persons who move from one area to another within their own country or across the borders to another country for employment. Migrant workers work for a limited period of time in the region that they have 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 workers: workers whose work by its character is dependent on seasonal conditions and is performed only during part of the year.

Temporary workers: persons who work at the company on a non-regular, short-term basis. A temporary worker may be a seasonal worker.

Definitions from the International Standard Classification of Occupation (ISCO) classification

Low-skill (or unskilled) workers include agricultural, forestry and fishery labourers.

METHODOLOGICAL NOTES

Information on earnings from waged work can be expressed in various forms depending on the crops, the task performed, the country, or the farm record keeping system. For instance, earnings can be expressed by volume of produce, by area covered, by number of plants, by piece. In order to calculate this indicator, data on earnings need to be normalised to wage earned per day of work.

While this indicator refers to the wages of all employees working on the farm, the priority group is the low-skill agricultural workers who are usually at higher risk of exploitation.

The first step in the indicator computation consists of the calculation of the average daily wage of each employed worker on the farm for the reference period.

$$\textbf{Average daily wage} \text{ (in local currency)} = \frac{\text{Total labour cost (sum of earnings of each working day)}}{\text{Total number of days worked}}$$

The average daily wages are then compared to the rural minimum wage (where that exists) - alternatively to the national minimum wage - in local currency to calculate the pay gap expressed as a percentage of the (rural) minimum wage.

$$\textbf{Pay gap (\%)} = \frac{\text{Average daily wage} - \text{Minimum wage}}{\text{Minimum wage}} \times 100$$

Finally, the formula to calculate **the proportion of workers earning equal or above the minimum wage** is:

$$\frac{\text{Number of workers with a pay gap equal to 0 or positive}}{\text{Total number of workers}} \times 100$$

In alignment with ILO recommendations, labour statistics should be disaggregated by sex and age. The age groups used can vary (5-year or 10-year age bands, for instance) but they should always at the very least ensure a distinction between youth (ages 15 to 24) and adults (ages 25 and over).

LIMITATIONS

- Workers can be employed for less than a full day, therefore measuring hourly wages as in the SDG indicator 8.5.1 is more accurate, but more data intensive;
- Issues with the accuracy of information on earnings is the most frequently raised challenge as respondents may over declare or under declare their earnings for various reasons, or they may declare gross wages including bonuses and benefits;
- Comparability among earnings statistics present a number of challenges, most of which arise from the variety of possible sources of data and conversion rates.

KEY REFERENCE MATERIAL

- Fairtrade Standard for Small-scale Producer Organizations, 2019
- Minimum Wage Policy Guide, ILO website
- International Standard Classification of Occupation (ISCO-08 - code 92
ILO Minimum Wage Fixing Convention, 1970 (No. 131).

12. INCIDENCE OF CHILD LABOUR

This indicator tracks the employment of children below the age of 18 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, that is harmful to physical and mental development and interferes with their ability to attend regular school. 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. Whether or not particular forms of "work" can be called "child labour" depends on several factors, and especially on the child's age, the type and hours of work performed, and the conditions under which it is performed.

Furthermore, the **worst forms of child labour include** children being exposed to serious hazards such as pesticides. Child labour in cotton and coffee production has been reported in several countries, primarily as a consequence of the low farm income.

Assessing the incidence of child labour in the field is complex and sensitive. Collaborations with UN dedicated agencies such as FAO, UNICEF and ILO, and with international or local non-governmental organisations present a real opportunity to proactively work in many countries on child labour.

Dimension	Social
Area	Child labour
Unit	Number of children aged 5–17 years engaged in child labour, by sex and age (during the reference period)
Relevance	All farms
Target	0% - Exclusion criterion for sustainability standards
Data points	• Audits results (for sustainability standards) • Age and sex of the child • Hazardous working tasks of the child (as per categories provided in the definition of hazardous work and to be contextualised to the farming conditions/commodity) • Working hours per hazardous activity (optional) • Hazards associated with the agricultural tasks
Data collection	Yearly
Reporting	Yearly
Data sources	Secondary data on child labour (if existing) Interview with farmers, children, teachers; household survey; school attendance, relevant hospital records
SDG reference	8.7.1: Proportion and number of children aged 5-17 years engaged in child labour

DEFINITIONS

Definitions from the relevant ILO Conventions

Child labour reflects the engagement of children in prohibited work and, more generally, in types of work to be eliminated as socially and morally undesirable as guided by national legislation, the ILO Minimum Age

Convention, 1973 (No. 138), and the Worst Forms of Child Labour Convention, 1999 (No. 182), as well as their respective supplementing Recommendations (Nos 146 and 190).

Child labour is work that impairs children's well-being or hinders their education, development, and future livelihood. The Convention on the Rights of the Child (UN, 1989) recognises and emphasises 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 worst forms of child labour involve children being enslaved, separated from their families, exposed to serious hazards and illnesses and/or left to fend for themselves on the streets of large cities – often at a very early age.

One of the worst forms of child labour is **hazardous work** (ILO Convention, 1999, No. 182). In the context of crop production, it 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.** For all full description of the definitions refer to the FAO Handbook in the key references.

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 for ordinary work (14 years) and for light work (12 years). Hazardous work, however, should never be conducted under the age of 18.

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.

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 for more than 14 hours/week and/or under dangerous or exploitative conditions and their parents or guardians supervise and guide them.

METHODOLOGICAL NOTES

Monitoring the incidence of child labour is a complex issue that requires a significant amount of resources and time. It requires trained social workers and a sound methodology that takes into consideration the ethical dimensions pertaining to informed consent, privacy and confidentiality, harms and benefits, and risk management (see UNICEF Procedure for Ethical Standards in Research, Evaluation, Data Collection and Analysis).

Certified sustainability standards primarily monitor the incidence of child labour through third-party audits. For monitoring and planning purposes, however, these standards, and other agribusiness actors, have recWently introduced risk-based scores/maps that estimate the likelihood or potential (risk) of child labour in a given country/area. These scores combine relevant public indices on work conditions, access to education, and respect for human rights in a country with contextual information about the crop and production processes. Overall, these scores/maps provide important background information; they do not however factor in sub-national variations or data about individual producers' performance. Also, risk maps do not reflect the actual occurrences of child labour.

Country risk maps: country-level Child Labour And Forced Labour Sectoral Risk Maps are available on the Rainforest Alliance (RA) website for coffee and other commodities (not including cotton) for several countries. The sector risks per country for child (and forced) labour is calculated based on two components:

- "Structural or external factors" derived from national data on the regulatory and socio-economic environment. This component uses proxies suitable for gauging the likelihood that children could be working in a given country, e.g., UNICEF Children's Rights in the Workplace Index, and
- "Risks in practice or internal factors" which are risk drivers and root causes specific to the sector in question in each country. Risk in practice is scored using data drawn from RA institutional knowledge on the sector in specific countries.

Country-level risk maps for child labour on cotton, and for other countries which are currently not available on RA website, can be developed using the RA technical guidance.

Farm vulnerability level: a similar risk-based approach can be used at farm level to assess the farm's vulnerability to child (and forced) labour.

Measuring Incidence: The incidence is measured by the number and proportion of children engaged in child labour. For more information on the statistical definitions used to measure child labour refer to the resolution concerning statistics of child labour.

The minimum variables to be collected to establish the incidence of child labour are:

- Age and sex of the child
- Working hours per day/week (or average hours)
- Hazardous working tasks of the child (to be contextualised to the farming conditions)

- Hazards associated with the agricultural tasks

Some additional data to better interpret the extent of the impact of child labour on the wellbeing of children include:

- 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)

In terms of number of hours that define a child engaged in economic activities, ILO uses the following categories:

- children 5–11 years old who, during the reference week, did at least one hour of economic activity,
- children 12–14 years old who, during the reference week, did at least 14 hours of economic activity,
- children 15–17 years old who, during the reference week, did at least 43 hours of economic activity.

Two important references to design an ad-hoc assessment of the incidence of child labour are:

- 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; and
- The ILO Manual on child labour rapid assessment methodology, a practical guide for users ranging from researchers to non-governmental organisations, community-based organisations, ministries, and other governmental agencies.

In the context of the Delta Framework, it is recommended to use available approaches at different scale to measure, monitor, and address child labour, namely:

- Use/develop country risk maps to identify countries at high and medium risk of child (and forced labour);
- Assess farm-level vulnerability to identify farms where further investigation is required; and
- Carry out assessments of the actual incidence of child labour at farm level.

The number of children in child labour should be available disaggregated by sex, and also separately for the different age subgroups making up the child-age band (for instance, using the two age sub-bands 5 to 14 and 15 to 17).

REPORTING

The elimination of child labour from agriculture is a shared goal by private and public institutions, and for the sustainability standards 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.

Reporting options include:

- Reduction in percentage of children under the legal working age by sex;
- Reduction in percentage of children engaged in hazardous work by sex.

LIMITATIONS

- Challenges in collecting reliable information on sensitive data, including verification of children's age;
- The monitoring of child labour's incidence involves a significant investment in terms of financial resources, time and human capacity. A diversified approach comprising of formal and informal assessment methods is required to generate reliable and meaningful information. Therefore, the use of VSS audit results as the only means to establish whether child labour is employed in the production of cotton, coffee or any other commodity might not be sufficient and could potentially lead to underreporting.
- Need to comply with national legislations on personal data protection and prior consent.
- Possible differences between national labour laws and ILO definitions and guidance.

KEY REFERENCE MATERIAL

- FAO Handbook for monitoring and evaluation of child labour in agriculture
- ILO Manual on child labour rapid assessment methodology

13. INCIDENCE OF FORCED LABOUR

This indicator tracks the systematic or individual use of forced labour in cotton and coffee production. Forced Labour remains an issue 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 sex and age
Relevance	Countries with reported incidence of forced labour
Target	0%. Exclusion criterion for sustainability standards
Data points	• Country risk maps • Farm vulnerability level • Audit results (for sustainability standards)
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

Definitions from guidelines concerning the measurement of forced labour, 2018, ILO

Forced labour. Forced labour includes work or service exacted from a person under threat or penalty (or where the person has not offered him or herself voluntarily), 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.

METHODOLOGICAL NOTES

Forced labour in a country or in a specific sector is usually monitored under the auspices of international human rights agencies and collaborative governments.

Similarly to child labour, measuring the actual incidence of forced labour is challenging and sensitive. Standards have therefore moved towards the adoption of risk-based monitoring approaches that primarily estimate levels of contextual risk of forced labour based on specific variables, e.g., poverty, migration, informal economy, legislative framework. The methodological notes provided for child labour largely apply to forced labour.

Country Risk Maps: country-level Child Labour And Forced Labour Sectoral Risk Maps are available on the Rainforest Alliance website for coffee and other commodities (not including cotton) for several countries. BCI has developed a specific methodology for forced labour in cotton (Forced Labour Global Risk Assessment Methodology) which establishes the country level risk of forced labour in cotton production for countries where Better Cotton operates. These risk-based approaches are used to prioritise further investigation and investment into the mitigation of forced labour where the risk is elevated.

Farm vulnerability level: a similar risk-based approach can be used at farm level to assess the farm's vulnerability to child (and forced) labour.

Measuring incidence: There isn't an agreed, common methodology to collect data on forced labour. There are however good examples, well aligned with international guidelines. Data on forced labour can be collected through a dedicated survey or as part of household income and expenditure surveys, as well as through labour force surveys. Standard setting initiatives monitor the incidence of forced labour based on audits and additional qualitative assessments. The ILO identifies 11 signs or "clues" to help with the identification of persons who are possibly trapped in a forced labour situation. These signs are abuse of vulnerability, deception, restriction of movement, isolation, physical and sexual violence, intimidation and threats, retention of identity documents, withholding of wages, debt bondage, abusive working and living conditions and excessive overtime. Unfair contractual and payment arrangements could also be an indication of forced labour.

The Responsible Business Alliance has developed the Supplemental Validated Audit Process (SVAP) on Forced labour based exclusively on identifying the risk of forced labour at an Employment Site (e.g. factory) or Labour Provider (e.g. labour 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 labour.

Another example of a risk-based, on-the-ground forced labour monitoring can be found in Uzbekistan. International organisations and human rights activists have monitored force labour in the cotton growing areas in the country for over a decade The third-party monitoring of child labour and forced labour during the 2019 cotton harvest in Uzbekistan report by the ILO provides a detailed methodology.

KEY REFERENCE MATERIAL

- ILO Forced Labour Convention, 1930 (No. 29)
- ILO Guidelines concerning the measurement of forced labour

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 an important 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).[24]

This composite indicator for Women's Empowerment, developed in partnership with CARE International UK with reference to the IFPRI Women's Empowerment in Agriculture Index[25], is made up of 6 tried and tested sub-indicators across three domains: i) leadership, ii) decision-making, and iii) control of economic assets (for smallholder farms) or gender equality in the workplace (for large farms).

Dimension	Social
Area	Gender
Unit	Women's Empowerment scores
Relevance	All farms
Target	Increased women's empowerment
Data points	**Smallholder farms:** • Self-efficacy • Communication and negotiation skills • Collective action • Input into productive decisions • Control of productive assets • Gender equitable attitudes **Large farms:** • Self-efficacy • Communication and negotiation skills • Collective action • Input into workplace decisions • Gender equality policy • Gender equitable attitudes
Data collection	Yearly, or, if resources for data collection are limited, every 2 or 3 years
Reporting	Yearly
Data sources	Smallholder farms: Household interviews Large farms: Employees (seasonal workers; permanent workers; office staff/business employees)
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

24 Gender Equality and Women's Voice Guidance Note, April 2018

25 www.ifpri.org/project/weai

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: # of women and # of men reporting high levels of self-efficacy.
- Communication and negotiation skills: # of women and # of men reporting confidence in their communication and negotiation skills.
- Collective action: # of women and # of men reporting that they could work collectively with others in the community to achieve a common goal.

Decision-making:

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

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

Large farms: The skills, confidence, and abilities of women and men to input into workplace decisions. Sub-indicator:

- # of women and # of men who have meaningfully participated in decision-making process in the workplace/ or home (seasonal workers).

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

Gender equality in the workplace: (large farms) The existence of gender equality policy and confidence and attitudes held by women and men around gender equitable attitudes in the workplace. It is measured by 2 sub-indicators:

- # of large farms with at least one policy pertaining to gender.
- # of women and # of men who demonstrate gender equitable attitudes in the workplace.

METHODOLOGICAL NOTES

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 Smallholder farms:

$$\text{Women's Empowerment} = \text{Leadership 1} + \text{Leadership 2} + \text{Leadership 3} + \text{Decision-Making} \times 3 + (\text{Control of Financial Assets 1} + \text{Control of Financial Assets 2}) \times 1.5$$

Calculation Large farms:

$$\text{Women's Empowerment} = \text{Leadership 1} + \text{Leadership 2} + \text{Leadership 3} + \text{Decision-Making 1} \times 3 + (\text{Gender Equality 1} + \text{Gender Equality 2}) \times 1.5$$

Calculating a Gender Parity Score

Because questions are posed to the farmer and his/her spouse (for smallholder farm context) and women and men workers and staff (for large farm context), 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 for both smallholder farms and large farms have been developed on the aggregation method, achievement parameters, and inadequacy cut-off.

LIMITATIONS

- Gender issues and realities are highly sensitive and context specific. The use of a complementary qualitative assessment to contextualise results might be necessary.

15. RATE OF FATALITIES AND NON-FATALITIES ON THE FARM BY SEX

This indicator tracks the number of fatalities and non-fatal occupational injuries occurring on the farm while working on the cotton or coffee crop. Worker health and safety refers to the principle that workers should be protected from sickness, disease, and injury arising from their employment. A safe and sound work environment ensuring occupational safety and health at work is at the core of decent work. In the case of cotton and coffee production, a specific type of occupational hazard that deserves close monitoring is acute pesticide poisoning.

This indicator can also be useful to plan preventive measures and to estimate the economic consequences of occupational injuries, particularly in terms of days lost or costs.

Dimension	Social
Area	Farmers and workers safety
Unit	% of fatalities and non-fatal occupational injuries on farm (while working on the cotton or coffee crop)
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 reference period • # of fatal accidents on the farm in the reference period • # of non-fatal injuries requiring at least two days of lost time
Data collection	Yearly
Reporting	Yearly
Data sources	Administrative records, hospital records, farmers' interviews, national systems
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

Definitions from the ILO Convention 155 on Occupational Safety and Health

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.

METHODOLOGICAL NOTES

Occupational injuries are often underreported, which means that occupational injuries statistics from administrative records or registry systems may not be comprehensive.

The **fatal or non-fatal occupational injury rates** can be calculated separately using the following formula for the reference period:

$$\frac{\text{Number of new fatal or non-fatal occupational injuries on the farm}}{\text{Number of farmers and workers on the farm}} \times 100$$

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

KEY REFERENCE MATERIAL

- ILO Convention 155 on Occupational Safety and Health
- Official SDG Metadata
- Decent Work Indicators Guidelines for Producers and Users of Statistical and Legal Framework Indicators

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 highlighted in bold):

1. **4C Association***
2. **Better Cotton**
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 Organic Textile 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 (OCA)
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

Annex 3. HHPs List

Annex 4. Guidance for Irrigation Efficiency and Water Productivity indicators

Additional guidance to collect data points for sub-indicators #3b and 3c:

- Irrigation Efficiency
- Water Productivity

Annex 5. Detailed methodology & tools for Women's Empowerment indicator

Guidance and tools for the Women's Empowerment indicator, for smallholder and large farm contexts:

- 5.1 Developing the indicator
- 5.2 Integrating participants from large farms
- 5.3 Data collection guidance for enumerators
- 5.4 Enumerators training material - by CARE
- 5.5 Annual reporting template

Annex 6. Delta Framework Consultations Report

Annex 7. Delta Indicators Pilots Report

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