联合国粮食及农业组织 | Food and Agriculture Organization of the United Nations | Organisation des Nations Unies pour l'alimentation et l'agriculture | Продовольственная и сельскохозяйственная организация Объединенных Наций | Organización de las Naciones Unidas para la Alimentación y la Agricultura | منظمة الأغذية والزراعة للأمم المتحدة

COMMITTEE ON COMMODITY PROBLEMS

INTERGOVERNMENTAL GROUP ON TEA

TWENTY-FIFTH SESSION

Guwahati (Assam), India, 31 January-2 February 2024

ASSESSING THE CARBON FOOTPRINT OF TEA PRODUCTION: CASE STUDIES AND CHALLENGES

Executive Summary

Understanding the environmental impact of the entire tea value chain can help identify hotspots for improving and designing sustainable solutions to enable the sector to play its part in the transformative process needed to transit into greener agrifood systems. The objective of this document is to propose a methodology to measure the carbon footprint of the tea sector, and examine the data requirements and some other critical aspects in relation to the implementation of the proposed method.

Suggested action by the Group

The Group is invited to:

- Take note of the ongoing efforts to provide a first assessment of the carbon footprint of the tea value chain.
- Provide feedback on the methodology and data requirements.
- Discuss the way forward and the next steps, taking into consideration data and resource limitations.

Queries on the substantive content of the document may be addressed to:

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I. INTRODUCTION

1. At its last session, the Intergovernmental Group on Tea (IGG/Tea) noted the need to consider future strategies and appropriate enabling policies to cope with the challenges faced by the tea sector and to prepare the sector for the energy transition towards green production systems. It further highlighted initiatives that aim at reducing the carbon footprint of tea production, notably through extending low carbon technologies. For example, the FAO South-South and Triangular Cooperation project "Global Low Carbon Tea - Triangular Cooperation in Tea Value Chain in Kenya" has the objective of promoting the use of low carbon technologies in Kenya to combat climate change for a sustainable tea industry.

2. Combating climate change will require a global effort and far-reaching steps to preserve the sustainability of the tea sector. Tea is one of the world's oldest beverages and is the most consumed drink in the world, after water. It is available in many varieties, which differ according to the applied oxidation and fermentation technique. The tea sector is also an engine of economic growth for many low-income countries, and particularly the least developed countries. It contributes to rural development, poverty reduction and food security, representing, in several instances, a major source of income and employment for millions of poor families. For these reasons, the tea sector can help improve lives and increase the resilience of millions who are impacted by successive climate and economic shocks. Global tea production amounts to over USD 17 billion, while world tea trade is estimated at about USD 9.5 billion, accounting for an important source of export earnings. One key characteristic of tea is that smallholders are responsible for 60 percent of world tea production.

3. However, several factors challenge the environmental sustainability of the tea sector. The increasing global production for tea entails land-use changes which may include deforestation that affects ecosystems. Overuse of fertilizers, erroneous application of insecticides and weeding disturb the local biodiversity, as well as lead to soil degradation and soil erosion (Van Der Wal, 2008; Kumarihami and Song, 2018). The complex supply channel between tea-producing and tea-consuming countries increases the environmental impact from processing and shipping including pollution, emissions, and material use. Conversely, tea production is affected by climate change driven stresses including variability in temperatures and precipitation and occurrence of extreme weather events which reduce yields and quality. On the positive side, tea is a carbon sink and can play a significant role in mitigating climate change (He et al.,2022; Pang et al., 2019).

4. Tea production and consumption is a complex and multi-faceted process that raises important sustainability concerns. To ensure the long-term viability of the tea industry and protect the environment and communities, it is crucial to support responsible tea production. Understanding the environmental impact of the entire tea value chain can help identify hotspots for improving and designing sustainable solutions to prepare the sector for the transformative change needed to transit into a greener agrifood system.

5. The objective of this document is to propose a methodology to measure the carbon footprint of the tea sector, and to examine the data requirements and some critical aspects in relation to its implementation. The specific goal of this methodology is to estimate greenhouse gas (GHG) emissions throughout the tea value chain, encompassing the production, processing, and distribution stages within the country. The analysis excludes an assessment of the carbon footprint related to distribution outside the producing country and retailing. Overall, this research aims to raise awareness on how the tea industry can support climate actions, and to provide evidence-based information to decision makers.

II. METHODOLOGY

6. In assessing the carbon footprint of the tea value chains in the selected country case studies, the proposed methodology follows three main steps which are described below.

7. Mapping of the Value Chain. The first step includes the identification of the different actors, activities, inputs, and outputs across the different stages in the life cycle of the tea value chain in the selected countries. The focus is on production, processing, and distribution stages within the country.

8. Data collection for GHG assessment. The second step includes the collection of the data required to estimate the carbon footprint. The studies rely on official and publicly available data sources and may be complemented with expert opinions, if needed. Country and/or IGG Tea members have an important role in providing and complementing missing information, especially in the absence of primary or secondary data. The reference year for the data used in this study will be 2019 to avoid any potential inaccuracies caused by macroeconomic changes brought about by the COVID-19 pandemic.

9. Carbon footprint estimation. The third step calculates emissions generated from each of the inputs and outputs identified in the first step, such as carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O), using emissions factors and activity data based on methodological guidelines provided by the Intergovernmental Panel on Climate Change (IPCC).

10. The carbon footprint for the selected country case studies will be estimated using FAO's EX-ACT suite of tools, specifically: 1) the Ex-Ante Carbon-balance Tool (EX-ACT) for primary production emissions; and 2) the Ex-Ante Carbon-balance Tool for Value Chains (EX-ACT VC) for downstream emissions (transport, processing, packaging, and storage). Together, these tools allow for a comprehensive assessment of GHG emissions across each stage of the tea value chain being analysed.

11. EX-ACT is a land-use-based accounting system to evaluate the effects of the interventions in agriculture on GHG emissions and carbon stock changes expressed as carbon balance, in tonnes of carbon dioxide equivalents (tCO2-e). It covers the whole Agriculture, Forestry and Other Land Use (AFOLU) sector, fisheries, and aquaculture, agricultural inputs, and infrastructure. EX-ACT is based on the IPCC methodology for GHG emissions inventories[1].

12. EX-ACT VC is a quantitative multi-appraisal tool to evaluate the sustainability of agri-food value chains simultaneously along a set of environmental, economic, and social dimensions, allowing to estimate GHG emissions originating from downstream value chain activities, i.e., transportation, processing, packaging, storage, and infrastructure[2]. The environmental assessment mainly derives its methodology from IPCC guidelines (IPCC, 2006, 2019c), and GHG protocol (Bhatia et al., 2011, WRI, and WBCSD, 2013), among others[3].

13. The two tools are designed to compare a baseline scenario with business-as-usual conditions against a planned scenario which includes potential policy changes/interventions. The design and

[1] The current version of EX-ACT is primarily based on the IPCC reports "Refinement to the 2006 Guidelines for National Greenhouse Gas Inventories" (2019) and "Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands" (2014), complemented by other scientific research (FAO 2022a).
[2] It also quantifies food losses at different stages of the value chain, and water use in processing; calculates value-added indicators and employment generation potentials; and analyses women and youth participation along the value chain.
[3] Global Logistics Emissions Council Framework (Greene and Lewis, 2019) and Smart Freight Centre (2019), FAO(2022a), FAO(2022b) Agence de la transition écologique (ADEME, 2020) and Breisinger (2012).

analysis of alternative planned scenarios will be taken into consideration only if resources, time, and data availability will allow.

III. DATA REQUIREMENTS

14. The data required to estimate the carbon footprint of the tea value chains using EX-ACT and EX-ACT VC tools are reported in Table 1. These will be collected through specific questionnaires sent to the tea boards/associations of the selected country case studies, as well as through desk research and expert consultations.

Table 1. Data requirements for GHG assessment using EX-ACT and EX-ACT VC

Activity	Data requirements	Unit/Options
Tea cultivation and harvesting	Tea cultivation area	Hectares
	Location of tea plantations – climate and soil characteristics	-
	Tea yields	Kg/ha or tonnes/ha
	Agroforestry system	-
	Tillage management	Low/medium/full tillage
	Input of organic material	-
	Residue management	Burning/not burning residues
	Fertilizers and pesticides	Tonnes/ha, or litres/ha No. hectares on which they are applied
	Fuel use (on-farm machinery)	Litres/year, or tonnes/year
	Irrigation system	e.g., surface, sprinkler, drip
Transportation (e.g., between field and processing plant, to market, etc.)	Average distance travelled	Km
	Type of vehicle	Van, small/medium/large truck Ferry, train, plane
	Type of fuel	Diesel, gasoline, LPG, wood, peat, charcoal
	Refrigeration	Refrigerated/not refrigerated
Tea processing (e.g., for withering, maceration, drying, etc.)	Transformation rate from tea leaves to made-tea (how much output per unit of input)	Percentage (%)
	Electricity use (machinery)	kWh/tonne of product to be processed
	Gaseous & Petroleum (machinery)	m3/tonne of product to be processed
	Other energy use e.g., wood	Tonnes of dry matter/tonne of product to be processed
Packaging	Type of packaging material	e.g., paper, card, plastic-mixed, plastic LLDPE
	Quantity of material	Kg/tonne of product
Storage	Electricity use	kWh/day
	Days in storage	No. of days
	Storage capacity	m3
	Refrigeration	Refrigerated/not refrigerated
	Refrigerant leakage	Kg/year

Source: Authors' elaboration

15. It is important to mention that data collection is the main challenge in carbon footprint assessment. Data listed in Table 1 are not always easily accessible, and probably several calculations and assumptions will be required. Moreover, value chains are complex and context-specific, and this will reduce the replicability of data used in similar analyses.

IV. CRITICAL DISCUSSION

16. The activities performed downstream the tea value chain likely produce GHG emissions, however, primary production is a carbon sink and can play a role in mitigating climate change, due to the capacity of the tea plants to absorb carbon dioxide present in the atmosphere through biomass and soil (Pramanik and Phukan et al., 2020).

17. Primary production. At the primary production level, agricultural practices (e.g., tillage, organic amendments, residue management) influence the capacity of sequestering carbon. The type of tea agroforestry system (e.g., the presence of shade trees, the type of cultivars adopted, along with the age of tea plantations, climate and soil characteristics) also play a key role. The application of fertilizers and pesticides is also a source of emissions, and the application of organic instead of chemical fertilization can reduce emissions. The use of on-farm machinery may entail fuel consumption and emissions. Irrigation may require substantial water use, and energy for pumping.

18. The benefits resulting from tea production in terms of climate mitigation potential should be balanced against unsustainable practices such as deforestation. As was highlighted on several occasions by IGG/Tea Group, the focus should be on improving productivity and efficiency rather than expanding area in a manner that is unsustainable from an environmental, economic and social point of view.

19. Processing. Tea processing requires energy consumption for withering, drying, cutting etc., which produces GHG emissions. Employing machinery with increased energy efficiency and/or using clean energy may reduce the impact.

20. Storage and packaging. Storage contributes to emissions through electricity and refrigerant use. Generally, tea does not require refrigerated storage, hence the impact of tea storage may not be substantial. Packaging is a source of emissions in that it entails the manufacturing of the packaging materials, which requires energy use. The impact of packaging will depend on the final market segments and on the type of material used – and on its sustainability. At the same time, storage and packaging are important to preserve the product and reduce losses.

21. Transport. Transportation along the value chain entails fuel use, hence emissions, especially when the product travels long distances before reaching the markets. Transport plays a key role in emissions in the tea value chain, as the commodity travels between producing and consuming nations.

22. Retail and final consumption. Retail and final consumption contribute to emissions, through the related energy use (e.g., boiling the water for tea preparation, packaging, and transport). However, it is very difficult to collect precise data at these stages and define properly the boundaries of the analysis at this level. This is also outside the boundaries of the current analysis, and beyond the scope of the tools used.

23. The outcomes of a preliminary simulation exercise performed for Assam tea value chains using secondary data are in line with the above theoretical observations. Activities downstream the tea value chain generate GHG emissions, however, primary production can play a key role in providing important mitigation benefits and improved agricultural practices can heighten the potential of tea as carbon sink. Primary data and expert validations on data assumptions can further refine the preliminary analysis and improve the accuracy of the estimations.

V. NEXT STEPS

24. It is suggested that one of the Working Groups of the IGG undertakes the analysis of assessing the carbon footprint of tea production, processing, and distribution stages within the country, with the technical support of the secretariat regarding FAO methodology and tools.

25. Prior to undertaking the analysis, a thorough assessment is needed to review the data availability vis-à-vis the requirements listed in Table 1. In turn, this will inform the country-specific strategies for the data collection, relying on both primary questionnaires and secondary data sources to fill the existing gaps. Primary data on production practices and value chain structures can help refine the analysis. Secondary data sources and any further assumptions such as energy use etc., must be validated by experts from the different countries and IGG/Tea members.

26. GHG assessment of current/baseline scenario. Once data are collected and validated, GHG assessments for the different country case studies will be performed and total emissions and carbon footprint across the tea value chain will be estimated and validated for the year of analysis. Similarly, the preliminary analysis for the Assam tea value chain will be updated and completed based on the new available evidence.

VI. POTENTIAL EXTENSIONS

27. Socio-economic assessment. Complementing the carbon footprint analysis with a socio-economic assessment can help understand synergies and trade-offs between environmental and socioeconomic impacts of the tea value chain. This includes if and how the sector creates value for the economy, if value chain participation is profitable for the actors, how and where employment is generated.

28. Extension of the carbon footprint assessments to different contexts. The multiple assessments of tea value chains in different countries could help identify common trends, find sustainable solutions, and facilitate cross learning.

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