Assessing Emissions in Coffee and Cocoa Supply Chains: Data-Driven Approaches for Sustainability

Abstract

Coffee and cocoa production play an essential role in global agriculture, yet their supply chains contribute significantly to greenhouse gas (GHG) emissions. Understanding emission drivers such as land use change, fertilizer application, and crop residue management is key to reducing their carbon footprint. This article explores these drivers, emphasizes the need for primary data, introduces ECOM's Green Meter tool (officially reviewed by SustainCERT), and discusses strategies and trade-offs in implementing sustainable practices. Lastly, we highlight the importance of continuous monitoring and agronomic expertise to design interventions tailored to farmers' realities.

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1. Carbon Emissions in Coffee and Cocoa Production

Coffee and cocoa production are associated with several emission hotspots. Secondary data has identified land use change, particularly deforestation, as a primary contributor to emissions in tropical regions where these crops are grown. Additionally, the use of nitrogen-based fertilizers, inefficient crop residue management, and emissions from transportation within supply chains are significant contributing factors.

Land Use Change, Fertilizer use, Residues and Transport as main emission drivers based on secondary data

Emissions from the use of fertilizers and pesticide production, as well as general land use conversion data, are commonly estimated from global databases. However, these generalized datasets frequently overlook the nuances of specific farming systems, making the findings less actionable for stakeholders seeking targeted interventions.

The variability in reporting standards and the scopes of carbon footprint estimations also complicates the comparison of carbon footprints across studies.

2. The Importance of Primary Data

While secondary data provides a broad perspective, it fails to capture the complexity of farm-level practices and regional environmental conditions. Primary data, collected directly from farms and supply chains, offers critical insights into actual emission sources, allowing for tailored interventions and effective decarbonization.

For example, we have observed that the type and quantity of nitrogen fertilizer applied vary widely among farmers, affecting nitrous oxide emissions. Similarly, practices such as crop pruning or residue burning may generate emissions but also serve agronomic purposes, such as enhancing productivity. By integrating primary data into carbon calculations, stakeholders can better assess these trade-offs and design interventions suited to local realities, as well as their carbon impact. Primary data collection also drives transparency and accountability, forming the backbone of accurate carbon footprinting tools like ECOM's Green Meter.

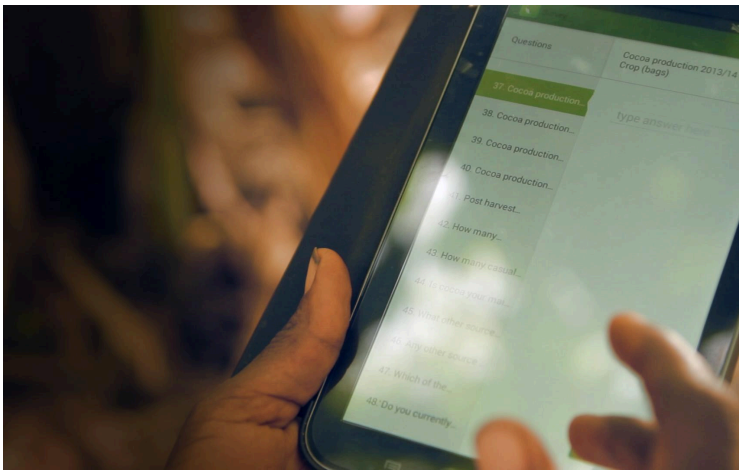
3. Green Meter: A Tool Built with Ground-level Expertise

Green Meter by ECOM Carbon Management Services

Recognizing the need for primary carbon emissions data, ECOM has developed Green Meter, a bespoke carbon calculator for coffee, cocoa, and cotton supply chains. This tool, now officially reviewed by SustainCERT and aligned with the GHG Protocol's Land Sector and Removals draft Guidance, provides robust estimates of carbon emissions and removals.

Green Meter's unique strength lies in its integration of field-level knowledge. Developed in collaboration with Meo Carbon Solutions and informed by our Sustainability Management Services (SMS) teams across different origins, the tool captures emissions from key activities such as fertilizer use and crop residue management, amongst others. Its capabilities include:

- Detailed carbon footprint analyses across projects, countries, strata, and commodities.
- Detailed carbon footprint analyses from farm to port, including primary processing.
- Emission category breakdowns to identify high-impact areas.
- Compatibility with multilingual surveys for efficient data collection.



Through pilots and training conducted across ECOM origins, Green Meter has been tailored to reflect real-world farming conditions. This enables ECOM and its clients to design interventions that are both practical and impactful.

4. Reducing Carbon Footprint: Strategies and Trade-Offs

Reducing emissions in coffee and cocoa supply chains involves adopting sustainable practices that address key emission sources. It is important to focus on the key drivers of emissions, as well as consider the benefits for producers and for the climate. For example, preventing deforestation is critical to reducing land use change emissions, while ensuring no future deforestation means working closely with producers to keep lands productive and bring incentives to minimize any risk of potential deforestation.

Other measures such as improving fertilizer management, using biofertilizers or reducing nitrogen inputs can significantly reduce nitrous oxide emissions. Soil conservation practices, such as cover cropping, offer a dual benefit of fixing nitrogen naturally and protecting soil from erosion, thereby enhancing long-term productivity. Additionally, on-farm composting and biochar production can transform crop residues into valuable inputs, reducing emissions while improving soil fertility.

However, each intervention comes with trade-offs that must be carefully managed. Pruning, for instance, generates residues that release emissions when burned or decomposed but is essential for maintaining crop productivity. Similarly, biochar production from pruning residues is a promising carbon sequestration method but requires tools and knowledge that may not be accessible to all farmers. Agroforestry systems provide benefits such as shade, biodiversity conservation, and soil health improvement, but excessive shade can reduce yields if not optimized for local conditions. These examples illustrate the complexity of implementing sustainable practices and the importance of tailoring solutions to specific contexts.

The expertise of agronomists and field teams is indispensable in evaluating these trade-offs. Local knowledge ensures that interventions are not only environmentally beneficial but also economically viable and practical for farmers to adopt.

5. The Value of Continuous Monitoring

Sustainability is not a static goal but an evolving process that requires ongoing assessment and adaptation. Continuous monitoring enables stakeholders to measure the effectiveness of interventions, refine strategies based on outcomes, and respond to changing environmental or economic conditions. For example, tracking nitrogen fertilizer use and its associated emissions over time allows for adjustments that improve efficiency without compromising yields. Similarly, monitoring the adoption of soil conservation practices can identify barriers to implementation and inform capacity-building efforts.

Transparent and consistent reporting builds trust among stakeholders, including farmers, clients, and consumers. By integrating monitoring frameworks into tools like Green Meter,

ECOM ensures that its sustainability initiatives remain data-driven, scalable, and aligned with global standards.

6. Conclusion: Local Knowledge for Global Impact

Sustainable coffee and cocoa production requires more than just technical tools; it depends on the deep, context-specific knowledge of agronomists and field teams working directly with farmers. At ECOM, we recognize the critical role of leveraging our "boots on the ground" in designing interventions that address carbon emissions while supporting farmer livelihoods. Agronomic expertise ensures that recommendations are realistic, relevant, and adaptable to the diverse realities of farming systems.

As we continue to roll out Green Meter across origins, we emphasize the importance of combining science-based tools with local insights. This approach not only helps us reduce emissions but also promotes the resilience and prosperity of farming communities. Our goal is to build a sustainable future where farmers thrive, ecosystems are protected, and supply chains contribute positively to global climate goals.

7. Takeaways

- Main drivers of emissions: Key contributors include land use change, fertilizer use, and crop residue management.
- Primary Data: Essential for precise, actionable carbon footprinting and targeted interventions, and being the first step to decarbonization.
- Continuous Monitoring: Ensures transparency, accountability, and the ability to adapt to changing conditions.
- Agronomic Expertise: Local knowledge is vital for designing interventions that work in practice and support farmer livelihoods.