Specialty Coffee Association

A Specialty Coffee Association Report

Carbon and Coffee:

GHG Emission Reductions Progress and Strategies Across the Value Chain

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About This Report

Purpose

Climate change has widespread effects on coffee production, impacting the entire value chain, from producers to consumers. Effective solutions necessitate not only a renewed environmental focus, but also the close consideration of economic and social factors. It is now more important than ever for the industry to come together to discuss these solutions and factors, and share their collective knowledge and expertise for the benefit of all, but particularly in support of the most vulnerable: the small-scale agricultural producers who constitute the majority of coffee growers worldwide.

In 2016, the SCA identified carbon footprint measurement and reporting as one of five key recommendations to address climate change in a white paper, *Climate Change and Coffee: Acting Globally and Locally*.[1] As time—and the climate crisis—has progressed, the SCA continued to note that gaps in our collective knowledge around carbon emissions reporting and reduction remained a significant challenge to companies seeking to engage in this kind of activity.

This report aims to highlight some of the key tools, strategies, and best practices that coffee industry actors could adopt to achieve carbon emission reduction as well as encourage more targeted conversation about verifiable methods and outcomes, in order to increase proven and positive action on climate change throughout the entire coffee sector.

1 Specialty Coffee Association. Climate Change and Coffee: Acting Globally and Locally (2016).

Introduction

The ongoing threat of climate change, and the impact it is expected to have on coffee yields worldwide, is of particular concern to the global coffee sector in 2022.

According to recent reports, climate change is continuing to affect land patterns, making existing coffee land less compatible with production, and resulting yields less robust. If production practices and related technologies do not adapt, this issue is also likely to cause producers to abandon the cultivation of their coffee altogether, further decreasing agricultural output.[2] Such projected decrease in both land availability and yields coincides with an anticipation of sustained growth related to the global demand for coffee, which is expected to drive cultivation to new areas, leading to increased deforestation and the destruction of forest ecosystems.

Meeting the current demand forecast would require at least doubling the current levels of coffee production within the next 30 years.[3] If this new production is to be met through deforestation and full-sun modes of cultivation—as anticipated—the inherent risk to primary forests as well as intact natural habitats is potentially substantial. Meanwhile, since deforestation and intensified agriculture also increase carbon and other greenhouse gas (GHG) emissions, estimates suggest that, without considered action to mitigate GHG emissions, the coffee sector will be responsible for emitting 1.65 to 3.3 gigatons (Gt) of carbon by the year 2050.[4] This, in turn, will worsen the effect of climate change on coffee yields and could lead to even more deforestation.

In light of this harmful and destructive cycle, preservation of forest, climate adaptation and mitigation, and substantial carbon emission reduction have all become key goals for many companies worldwide. Specifically, a number of actors within the coffee industry have already taken steps to reduce their carbon footprint or achieve carbon neutrality, as they are keenly aware that ongoing emissions will exacerbate the challenges of climate change. They further understand that there is potential for carbon sequestration and overall carbon emission reduction at the farm level as well as throughout the entire value chain.

Several tools and strategies have been deployed in the last decade to support actors in mitigating carbon emissions and reducing the carbon footprint of certain actions. However, an increased exchange of ideas and opportunities between members of the coffee industry is needed, so that those who have successfully reduced their carbon footprint can share their knowledge and perspective with others. In response to this need, The Chain

2 Dr. Katalin Solymosi and Grit Techel, "Brewing up Climate Resilience in the Coffee Sector: Adaptation Strategies for Farmers, Plantations, and Producers," 2019.

3 Sjoerd Panhuysen and Joost Pierrot, "Coffee Barometer 2018," Hivos.

4 Sjoerd Panhuysen and Joost Pierrot, "Coffee Barometer 2020," Hivos (p20).

Collaborative, in partnership with the Specialty Coffee Association (SCA) and the Environmental Science Program at Whittier College, launched a qualitative and quantitative research project in 2021.

The end goal was to create an industry-wide report that would identify key tools, strategies, and best practices that coffee industry actors could adopt to successfully achieve carbon emission reduction. The present report is the result of this work.

Approach and Methodology

This project was conducted between October 2021 and May 2022. In 2021, we (the lead researchers) met with members of SCA staff to design a research project that would answer the following question: What tools and strategies have companies and organizations within the coffee value chain adopted, or what tools and strategies do they plan to adopt, to measure and reduce their carbon and GHG emissions? We then developed a mixed-methods methodology and scope of work to assist in recruiting three students from Whittier College to serve as members of the research team. Following the recruitment phase, the selected students were all onboarded in October 2021 to conduct four phases of work for the project.
The first phase consisted of a short literature review to assess the impact of and basic accounting methodologies for GHG from agriculture. The team also focused on the extent of GHG emissions in coffee to better contextualize data and definitions.

The second phase of the research included a desk review and analysis of information available through the websites and downloadable reports of 49 organizations and companies working within the coffee sector. This phase culminated in the development of a data set documenting the carbon emission reduction efforts that have been either proposed or enacted, and that have been shared publicly online.

The third phase saw the drafting of an online quantitative survey. Questions were geared toward understanding current best practices and available tools used to properly assess and reduce GHG emissions within the coffee value chain. The anonymous survey was advertised on various digital platforms (social media, e-newsletters, etc.) as well as through direct email outreach to several coffee industry contacts, which was facilitated by the SCA. In total, 22 people completed the survey, representing global traders, roasters, public sector organizations, civil society/non-profit organizations, advocacy organizations, and research institutions.

Finally, conducted simultaneously with the third phase, the team's fourth phase focused on the development and application of qualitative interviews to gather primary data and feedback from company and organization representatives. In total, nine institutions participated in the interviews, including representatives from sustainability-focused organizations, roasting companies, and trading companies. This report

does not disclose the names of interviewees to respect the requests of several participants.

Limitations

The trends that emerged from this study are of great relevance for the coffee industry as a whole as they capture an array of best practices and tools that, taken together, can help the industry move forward in its efforts to reduce or eliminate carbon and other GHG emissions. However, it should be noted that the analysis presented here focuses primarily on large or multinational corporations, some of which are vertically integrated. There is value in learning from larger companies and organizations, of course, as these entities tend to have—in comparison to smaller entities—more funds they can leverage to engage in research or pilot projects. Though, given the focus on large companies, it remains unclear what specific limitations and roadblocks small enterprises, regardless of their position in the value chain, encounter.

In addition, while the large companies and organizations reviewed in this study appear to be motivated to invest in carbon emission reduction practices at the level of production and cultivation, as well as throughout their entire value chain—evidenced through reported actions and financial intervention—the direct voice of growers is missing from this report. Finally, the survey and interview respondents account for a modest, albeit representative sample of the value chain. Survey response rates were lower than expected and it is unclear if this was due to limited visibility and outreach or other reasons that the researchers could not anticipate. Ideally, future iterations of this study should rely on more targeted outreach to obtain feedback that is as representative as possible of the variety of experiences throughout the coffee sector.

Phase One:
Literature Review

About This Phase

Phase one of this research was conducted between October 2021 and May 2022 and consisted of a literature review of relevant peer-reviewed articles and reports pertaining to carbon and other GHG emissions as well as accounting methodologies for agricultural production. The focus was on agriculture overall as well as on coffee more specifically. The goal was to identify key terminology and accounting protocols that have large industry relevance. This phase also sought to define direct and indirect emissions as they are measured across the value stream and provide examples from the coffee sector. Lastly, phase one identified key studies that have investigated carbon emissions more broadly and carbon emission hotspots within the coffee value chain, which were used to evaluate potential discrepancies and inconsistencies across accounting methods. The literature review also allowed for the identification of areas of opportunity for further investigation in possible subsequent phases of this research.

Key Findings

Despite the diverse number of protocols available, the coffee industry seems to rely greatly on the Greenhouse Gas Protocol (GHGP) developed in 1998 by the World Resources Institute and the World Business Council for Sustainable Development. The GHGP distinguishes GHG emission into three different scopes: direct GHG emissions (Scope 1), electricity indirect emissions (Scope 2), and all other indirect emissions (Scope 3).[5]

Even with the GHGP, the coffee industry has struggled to quantify carbon footprint baselines for each scope due to a lack of standardization both across accounting tools and reporting methodologies, but also due to the variability and complexity of coffee's global production and transport-related activities in various contexts. Further adding to the difficulty of assessing carbon and other GHG emissions accurately across the entire supply chain is the sense that companies do not feel like they have all the information they need, requiring some data to be sourced from third-party accounting firms. Additionally, while existing sustainability certifications may encourage some activities that lead to emission reduction, there are no specific regulations on emissions in any certification, and no scheme currently requires carbon accounting, making this a relatively new endeavor for coffee sector actors.

New legislation and the ongoing impacts of climate change confirm the pressing need to support companies and producers in reporting and

5 The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard (Revised Edition), World Resources Institute and World Business Council for Sustainable Development, March 2004.

reducing their carbon footprint, but the challenge of choosing the most effective tools and methodologies remains.

GHG Emissions from Agriculture

The global agricultural sector is considered a substantial contributor to climate change.[6] This is mainly due to GHG emissions that result from agricultural production, as well as from land-use change that destroys natural ecosystems (e.g., the conversion from forest to cultivated fields). Globally, agricultural production systems are estimated to contribute between 20% and 30% of total GHG emissions, according to various reports.[7] While GHG emissions include water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), ozone (O_3), and fluorinated gasses, special emphasis is given to carbon dioxide (CO_2) within the climate change discourse.[8] This is due to the fact that anthropogenic emissions of CO_2 into the atmosphere are the direct result of fossil fuel combustion and land use change, and also because, when CO_2 is emitted into the atmosphere, it has the ability to persist for millennia. Consequently, the CO_2 that has been emitted to date as a result of human activity continues to compound over time. This further exacerbates the climate change-related phenomena we see today: namely, of particular importance to this report, the continued release of CO_2 into the atmosphere by contemporary agricultural production systems, such as coffee. Within coffee production, emissions of CO_2 happen in multiple ways, including machinery fuel consumption, the production and transportation of fertilizers, and electricity use. Additional non-CO_2 GHG contribute greatly to the overall footprint of diverse agricultural sectors, and these include methane (CH_4) and nitrous oxide (N_2O). Emissions of CH_4 primarily derive from livestock production and fermentation processes, while N_2O emissions are largely associated with manure and fertilizer application.

In any given sector, total GHG emissions derive from the combined contribution of various gasses (such as CO_2, CH_4, and N_2O, each with different global warming potential).[9] To facilitate accounting and to allow for comparisons, GHG emissions are converted into a common unit: the carbon dioxide equivalent (CO_2eq). This normalizes the scale of emissions (e.g., individual, sector-wide, or country-specific) against the global warming potential (GWP) of CO_2 and allows actors to refer to their combined GHG emissions, converted into CO_2eq, as their "carbon footprint." Importantly, within the coffee supply chain, both water and electricity consumption can be converted into CO_2eq because of the GHG emissions associated with their production and treatment. However, while they can be accounted for as part of a company's total carbon footprint, both are often reported by corporations as separate from, or in addition to, total GHG. This is partially because water scarcity is a global issue, and water itself is a highly regulated commodity that has specific considerations not covered in GHG accounting. Water reduction mandates are also frequently in place in high-risk countries or regions, further emphasizing the need for corporations to directly report on their

6 Pete Smith et al., "Agriculture, Forestry and Other Land Use (AFOLU)," in Climate Change 2014: Mitigation of Climate Change: Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, ed: Ottmar Edenhofer et al. (Cambridge: Cambridge University Press, 2014).

7 John Lynch et al, "Agriculture's Contribution to Climate Change and Role in Mitigation Is Distinct from Predominantly Fossil CO_2-Emitting Sectors," Frontiers in Sustainable Food Systems, 03 (2014), DOI: 10.3389/fsufs.2020.518039.

8 According to the American Chemical Society, some GHG occur naturally as a result of natural processes (e.g., via organic material decomposition) and human activity (e.g., from fossil fuel use, heat production, and intensive agriculture). Other GHG have no natural sources and result from manufacturing and industrial processes. For more information, visit: Which Gases Are Greenhouse Gases? - American Chemical Society (acs.org).

9 Both CH_4 and N_2O are powerful GHG, more potent than CO_2 in trapping heat and contributing to climate change and global warming.

water reduction strategies. The intersection between energy and water consumption is additionally relevant, as reports indicate that switching to renewable energy sources could lead to significant reduction in water and other footprints, and consequently, in emissions of GHG.[10] For this reason and more, corporations may want to demonstrate the specific impact of their reductions or changes in energy use. For example, a corporation may want to highlight significant reductions in energy use in a certain area or facility, rather than solely reporting the impact of these reductions on their overall emissions company-wide.

As accounting and reporting methodologies can be very diverse, there is a critical need for comprehensive and standardized corporate GHG emission accounting strategies and systems that are internationally recognized. In response to this need, the World Resources Institute, together with the World Business Council for Sustainable Development, generated the Greenhouse Gas Protocol (GHGP) in 1998. This offers standardized tools to businesses and organizations to support the assessment of their own GHG emissions. It accounts for both direct and indirect emissions of any actor, categorizing them into three scopes (see Figure 1), and further distinguishes between product life cycle and corporate value chain emissions. The former relates to a particular product, such as a singular bag of roasted coffee, and follows the life of that specific product from raw material to use and disposal. Corporate value chain accounting and reporting, meanwhile, allows companies—such as a large roasting company—to assess all three scopes of their entire operation. In both cases, it is possible to identify opportunities for emissions reduction, but the corporate value chain approach is an internationally recognized method for companies wishing to account for their emissions and address their climate impact.[11]

10 Thomas Hundertmark et al., "Water: A Human and Business Priority," McKinsey, May 2020.

11 "Corporate Value Chain (Scope 3) Accounting and Reporting Standard," World Resources Institute and World Business Council for Sustainable Development, September 2011.

GHG PROTOCOL EMISSION SCOPES

SCOPE	DESCRIPTION	EXAMPLES (PRODUCING)	EXAMPLES (ROASTING)
 1	**Direct GHG emissions**	Emissions related to pruning, plant care, and on-farm processing, among others	Emissions used to roast and transport coffee to/from shops or facilities directly owned by the company
 2	**Electricity indirect emissions**	Emissions from the production of purchased energy for milling operations, offices, etc.	Emissions related to the generation of electricity for all electricity that was purchased to allow companies to operate their machines and facilities
 3	**All indirect emissions**	All emissions associated with the production of purchased inputs, including fertilizers, herbicides, etc.	All emissions generated from the production, processing, and importing of coffee, and the brewing and disposal of coffee, should roasting companies not directly own their own cafés or import operations

Figure 1. GHG Protocol Emission Scopes 1-3

Scope 1 refers to emissions from sources that a company or organization owns or directly controls. It would include, for example, the fossil fuels burned when roasting companies use their own trucks to transport bags of coffee to their retail shops.

Scope 2 refers to emissions that a company or organization indirectly causes when they purchase or use energy. As such, it includes emissions related to the generation of electricity offsite. These are considered indirect emissions, because while a company can control how often they turn on their lights, they do not control the emissions generated by electricity providers.

Finally, **Scope 3** relates to emissions that are not produced by sources which are owned by a company or organization itself. Rather, Scope 3 encompasses a variety of indirect GHG emissions that are associated with a corporation's activities across an entire value chain, even if those are not under that corporation's direct control—such as coffee growing, takeaway cup manufacture, wastewater production, etc. By and large, they can make up a vast majority of company emissions.

Scope 3 includes all GHG emissions not found within the first two scopes, and notably, was not designed within the GHGP to allow for comparison across companies or organizations. This is due to existing inconsistencies in methodologies and parameters used to assess specific sources of GHG throughout value chains. There is also a lack of clarity as to which actors are responsible for offsetting or reducing Scope 3 emissions, especially when these emissions can be shared (e.g., between companies who source from the same farms).

Coffee's Carbon Footprint

Global GHG emissions—be them from agriculture or any other sector—are contributing to climate change, causing higher global temperatures, and leading to reduced predictability of seasonal events. For example, present models predict that Mesoamerica is likely to be affected by lower rates of precipitation as a result of climate change—specifically, a 5% decrease in precipitation by 2050.[12] This change in rainfall, alongside other realities of climate change, will have negative consequences for the yield and health of many crops, coffee included. El Salvador and Nicaragua, for instance, are expected to see a 40% or greater decrease in land suitable for agricultural production over the next three decades.[13]

Small-scale agricultural producers are particularly vulnerable to climatic events and changes, as well as to the subsequent decline in productivity and quality of crops.[14] Climate risks also contribute to market volatility and price fluctuation, affecting actors up and down the coffee value chain in a variety of ways, especially those who are most resource insecure. As an example of this phenomenon, a drought in September 2020 followed by three frosts in Brazil led to a decline in production, contributing significantly to coffee price increases in 2021.[15] While such potential impacts of climate change on agriculture, coffee, and livelihoods are well documented, specific sources of GHG emissions associated with coffee production in its entirety are not well defined. However, comprehensive carbon assessments specific to coffee production *are* emerging, and some point to the fact that available accounting tools have (to date) largely ignored certain key elements within the coffee production system—in particular, the potential for coffee to sequester carbon in soil and the differences in emissions related to farm management type, such as conventional versus organic and shaded versus non-shaded agricultural production.[16]

Additionally, there is disagreement among value chain actors and GHG specialists alike as to the average emission rates of certain activities. Among the studies attempting to locate emission "hotspots" within the coffee value chain, one study conducted research with 116 working farms (sizes unknown) in Mexico, Guatemala, Nicaragua, El Salvador, and Colombia, and concluded that, even accounting for diverse production systems, 35% of all CO_2eq emissions in coffee production systems can be ascribed to fertilizer production. This study also suggested that post-harvest management practices make up approximately 50% of the total carbon footprint of coffee at the farm level.[17] Another study conducted in Costa Rica reported that, when taking into account the entire value chain, farm-level operations and milling together account for 43% of total emissions, while activities associated with consumption at the consumer level account for 46% of all emissions.[18] Other studies, however, argue that the most significant sources of emissions derive from coffee cultivation and production, not from the level of consumption.[19] Discrepancies in accounting for carbon and GHG emissions such as these are not

12 Maria Baca et al., "An Integrated Framework for Assessing Vulnerability to Climate Change and Developing Adaptation Strategies for Coffee Growing Families in Mesoamerica," PLoS ONE 9(2): e88463 (2014), DOI: 10.1371/journal.pone.0088463.

13 Baca et al, "Integrated Framework in Mesoamerica."

14 Eric Rahn et al., "Climate Change Adaptation, Mitigation, and Livelihood Benefits in Coffee Production: Where are the Synergies?" Mitigation and Adaptation Strategies for Global Change, 19 (2013):1119-1137.

15 Nora Burkey and Elisa Criscione, "Algrano Market Trends Review: Coffee Sourcing and Production Trends in the Context of a New Price Boom," Algrano, 2022.

16 Umesh Acharya and Rattan Lal, "Carbon Accounting for Coffee-Based Farming Systems," World Coffee Research, 2021.

17 Henk Rikxoort et al., "Carbon Footprints and Carbon Stocks Reveal Climate-Friendly Coffee Production," Agronomy for Sustainable Development, 34 (4) (2014): 887-897.

18 Bernard Kilian et al., "Carbon Footprint Across the Coffee Supply Chain: The Case of Costa Rican Coffee," Journal of Agricultural Science and Technology, Volume 3 (2013): 151-175.

19 Harry Hassard et al., "Product Carbon Footprint Product and Energy Analysis of Alternative Coffee Products in Japan," Journal of Cleaner Production, 73 (2014) :310-321, DOI: 10.1016/j.jclepro.2014.02.006.

uncommon, and largely depend on accounting methodology, tools, and parameters being used.[20] Such inconsistencies, together with the overall scarcity of data, further stress the need for accurate information gathering and sharing, and better communication regarding tools and best practices that can successfully and verifiably lead to lower carbon and other GHG emissions in the coffee sector.

Another element of variation in GHG accounting for coffee is that emissions are location-specific and highly dependent on the growing and processing methodologies used on-farm—which also varies across locations. While coffee production systems of all types contribute to CO_2 and other GHG emissions, and, consequently, to climate change, the extent of their contribution ranges. Small-scale agroforestry systems, for example, are considered to be significantly less impactful than full-sun modes of cultivation and, in some cases, may even sequester more CO_2eq than they contribute. This is especially seen when calculating emissions by unit of land, not by pound or kilogram of coffee (see Case Study #4 on page 40 for more information). Again, because of these differences—and units of measure applied—making generalized emission estimates across the coffee value chain is challenging, and findings are often inconsistent.

In addition, there is a lack of standardized data surrounding transportation. Not only do modes of transport vary by region, but reliance on such modes is prevalent and diverse for a countless number of activities in both producing and consuming nations—and anything taking place between the two. Activities that surround export—like aerial transport, overseas transport, and land transport from port to warehouse in specific locations—may have accessible records of emission (i.e., in the case of Costa Rican coffee traveling to the United Kingdom). However, other transport-related production activities—such as the transport of beans from farm to processing center on the back of a motorbike for hire—are harder to account for, especially for certain regions where there may be a dearth of records.[21] Transport of employees to and from their normal places of work, meanwhile, remains highly complex to quantify and is consequently even excluded from some standards, like the Publicly Available Specification 2050 (PAS 2050), a carbon standard created by the British Standards Institute and the British Department for Environment, Food, and Rural Affairs.[22]

Furthermore, though many sustainability certifications, such as Fairtrade and Rainforest Alliance, have been adopted by coffee companies and coffee growers alike as part of their efforts to foster environmental—as well as social—accountability, none of these certifications include direct standards related to GHG emissions.[23] Although their promotion of environmental conservation, erosion prevention, shade tree cover, and efficient use of machinery and fertilizer (to name a few) likely lead to GHG emission reduction, specific criteria around emissions and sequestration are absent.[24] This constitutes a potential gap in environmental sustainability, and challenges companies and growers from being able to leverage their existing certifications to verifiably meet new legislation.

20 Acharya and Lal, "Carbon Accounting for Coffee."

21 Bernard Kilian et al., "Carbon Footprint Across Coffee."

22 Bernard Kilian et al., "Carbon Footprint Across Coffee."

23 Fairtrade International has the Climate Standard, but this governs the sale of carbon credits which are certified as Fairtrade (i.e., carbon as product). Throughout the rest of Fairtrade's product standards, while there are both environmental suggestions and requirements, those requirements don't delineate carbon footprint caps.

24 Milena Segura and Hernan Andrade, "Carbon Footprints in the Coffee (Coffea Arabica L.) Productive Chains with Different Certification Standards in Costa Rica," Luna Azul, 35 (2012).

Several laws and regulations have been passed in both producing and consuming countries over the last few years, designed to tackle climate change and regulate GHG emissions. Among others, they include Costa Rica's National Plan of Adaptation to Climate Change, Uganda's National Climate Change Act 2021, Vietnam's Green Growth Strategy for 2021-2030, and the European Green Deal.[25]

In light of new legislation and ongoing impacts of climate change, there continues to be a pressing need to substantially support companies and producers to reduce their carbon footprint and report on their progress and emissions. Currently, a growing number of companies and organizations are taking steps to reduce their emissions or meet "carbon neutral" or "net zero" targets (two distinct terms that are often and erroneously used interchangeably, see the glossary for more information); the challenge remains choosing the most effective tools or methodologies to meet their goals, especially when present emission reduction strategies vary significantly across the value chain. It is the goal of this report to highlight some of these strategies and encourage more targeted conversation about verifiable methods and outcomes, in order to increase proven and positive action on climate change throughout the entire coffee sector.

25 For more laws and regulations, visit Grantham Research Institute on Climate Change and the Environment.

Phase Two: **Industry Research & Analysis**

About This Phase

Phase two of the research project took place between October and December 2021 and focused on a review of coffee companies' and sector-specific organizations' publicly shared sustainability claims, be they official reports, websites, or other outreach methods. Regardless of medium, their public-facing communication tended to be aimed at sharing ongoing efforts and current standing in regard to GHG emissions, environmental sustainability, and social justice actions. Notably, like other sectors, large companies in the coffee industry seemed to offer greater disclosure of verified emission rates obtained from the use of specific tools compared to small businesses.[26] The researchers speculate this is due to the expense of GHG reporting and verification, and the fact that legislation or consumer pressure may require public disclosure for only large companies at present. As such, findings for this portion of the report are skewed toward large companies and organizations. Despite this limitation, the subsequent analysis of 49 publicly available disclosures regarding GHG emission reduction efforts and climate actions reveal a diversity of focus and strategies.

26 Thomas Singer, "Sustainability Disclosure Practices: 2022 Edition," The Conference Board.

Key Findings

Current approaches are predominately focused on the accurate tracking and accounting of GHG emissions, particularly at the level of cultivation and production, to identify reduction targets. Two approaches appear to be the most common among respondents to mitigate coffee's contribution to climate change: land-based carbon sequestration (returning carbon to the soil and keeping it there) and investments in carbon credits.

Although curbing transportation-related GHG emissions remains a poorly addressed challenge (particularly in light of coffee's travels around the world), one possible approach may be to replace the value chain's use of fossil fuels with renewable forms of energy, though ongoing reliance on some forms of transportation makes a complete shift impossible. Solutions to address another key challenge in the widespread adoption of effective carbon emission reduction strategies—data sharing and accurate accounting—are also unclear, perhaps even more so.

Accounting Methods

Approximately 30% of the online reports reviewed through the desk research phase demonstrated that many ongoing emission reduction efforts are focused first and foremost on gathering accurate emission values through available monitoring and accounting tools. Such tools rely on satellite imagery and artificial intelligence, among others, and are most often applied at the levels of cultivation and production. Indeed, tracking GHG emissions in these contexts is seen as a critical first step toward decision-making prior to building strategy and establishing investments in carbon emission reduction. To better coordinate tracking and baselining efforts, many industry actors are increasingly calling for wider and more consistent adoption of reliable GHG and carbon footprint accounting, especially at the farm level. This helps provide further input into average emissions throughout the sector and supports industry actors to create more cohesive and comprehensive strategies for emission reduction.

The importer Cooperative Coffees, for example, is leveraging the Cool Farm Tool[27] to measure and incentivize further carbon sequestration at the level of cultivation and production in collaboration with their partner cooperatives. In particular, they are working with industry partners to better adapt the Cool Farm Tool to coffee production systems, in support of helping other industry actors make strides toward efficient carbon tracking and subsequent reduction. This project (for more information, see Case Study #3 on page 38) builds on their existing investments in regenerative, organic agriculture and reforestation throughout Latin America. Notably, the project also builds on their efforts to support their roaster partners to measure their carbon footprints from shipping ports to point-of-sale for consumers, for which they have an in-house tool.[28]

27 *Editor's Note:* One member of the research team, The Chain Collaborative's Nora Burkey, was a key collaborator in a project to adapt the Cool Farm Tool to coffee systems.

28 https://coopcoffees.coop/committing-to-net-zero-carbon-by-2025/

Common Strategies

Carbon Sequestration

Carbon sequestration, or returning carbon to the soil and keeping it there, is a valuable approach to mitigate coffee's contribution to climate change. Several companies are prioritizing GHG measurement and emission reduction through land-based interventions, which involve terrestrial carbon sequestration. This is taking place in two distinct ways. First, through direct investment in soil carbon capture on farms within a company's own value chain, and second, through reforestation and land conservation efforts elsewhere. These distinct strategies can also be understood, respectively, as examples of insetting versus offsetting.

Via insetting, coffee companies measure the GHG emissions throughout their own value chain and identify investment opportunities that will lead to emission reduction and/or carbon sequestration. Examples of such

investments may be supporting producers to transition to agroforestry, improve pruning practices, or apply fewer synthetic fertilizers. Meanwhile, offsetting allows companies to invest in carbon sequestration outside their own value chain in an effort to achieve neutrality. Investments to date identified through the desk research phase include support for wetland restoration, forest protection and preservation efforts, and afforestation as well as reforestation throughout Asia, Africa, and the Americas. For example, several companies, including Peet's Coffee and Lavazza, have opted to focus in part on investing in land restoration and conservation efforts outside their value chain. Lavazza is supporting forest cover in Peru, Uruguay, and Zimbabwe, while Peet's Coffee is sponsoring the planting of mangrove trees in Myanmar to offset emissions.[29] The latter project is coordinated in partnership with Worldview International Foundation, and monitored by Enveritas.[30]

Regardless of whether companies choose to inset or offset, the importance they have placed on focusing on land-based interventions and terrestrial or soil carbon sequestration is clear. While each company's stated motivation for prioritizing land-based interventions was not always clear, the authors note that above and below-ground carbon sequestration (in plants and soil, respectively) has the ability to take up atmospheric carbon through the photosynthetic process, and then store or "sequester" it in plant biomass and soil for the medium to long term. This effectively combats climate change and is an important focus for any company or organization working in the agricultural sector.

29 https://www.peets.com/pages/carbon-neutral-series-subscription.

30 https://www.lavazza.com/en/landing/capsules-zero-co2-impact.html.

Carbon Credits

Another common approach to reach carbon neutrality is direct investment in carbon credits. Carbon credits refer to certified emission reductions achieved through climate action projects, whereby one credit translates to one ton of CO_2 or CO_2eq sequestered. These projects and their resulting sequestration achievements are typically verified by third party organizations, which apply stringent qualifications to ensure accuracy in accounting. Companies and organizations purchase these credits to offset their own direct or indirect emissions.

Caravela Coffee, for example, measures their emissions throughout their value chain using a variety of tools,[31] and has offset their emissions through the purchase of carbon credits from Colombia-based non-profit Masbosques.[32] This is only one part of their strategy, as the company has also focused on insetting, including investing in a transition to renewable energy at their dry mill in Colombia in 2018 (see "Transition to Renewables," on page 18). This company example shows that purchasing offsets and participating in this part of the carbon market alongside insetting is a critical component to any strategy aimed at achieving carbon neutrality, especially considering that indirect emissions[33] outside a company's direct control are difficult to reduce (in particular, those related to shipping—see more information in "Fossil Fuel Reliance," on page 19).

31 To date, they have partnered with One Carbon World to estimate emissions across their supply chain, from farms to import offices, and with Cool Farm Alliance to estimate emissions from cultivation and production.

32 https://www.caravela.coffee/our-impact/

33 These can also be understood as a company's Scope 3 emissions, as described by the GHGP.

Beyond Caravela Coffee, another example of a company applying a similar approach is Zero Carbon Coffee, a roasting and retail company that has incorporated the purchase of carbon credits into their own strategy and emission reduction plans. On their website, they claim to have become "the first coffee brand to achieve Climate Neutral certification," after having measured their emissions in 2019.[34]

34 https://www.zerocarboncoffee.com/

Challenges and Opportunities

Fossil Fuel Reliance

For the most part, ongoing carbon emission reduction strategies seem to overlook transportation, despite the fact that, most often, green coffee moves across continents, and roasted coffee across countries, to meet global demand. Companies claiming to have developed strategies to address their transportation-related emissions are presently distinguishing between carbon emissions that are produced from the movement of coffee across land and oceans (e.g., freight emissions) from emissions that are produced when people travel for business (e.g., plane and car travel).

While the lack of focus on transportation may suggest that decarbonizing international shipping on a large scale is one of the most challenging aspects of emission reduction throughout the industry, opportunities do exist. Choosing shipping and vehicle options that boast higher fuel efficiency is one way to reduce emissions from freight and travel. There is evidence, for example, that slowing maritime shipping speeds to conserve fuel, utilizing kites and sails on the ocean, and making shipping freights use more sustainable electricity grids in ports are all viable options to reduce carbon emissions.[35] Present disruption in global shipping as a result of COVID-19 and other factors may of course hinder renewed focus on transportation going forward, as rising costs, lack of container availability, and the need to find new shipping routes are the priority focal points for many companies as of the writing of this report. However, even as the industry faces ongoing logistics challenges, the focus on emission reduction should not be an afterthought.

35 https://www.imo.org.

Transition to Renewables

Investments in renewable energy in both majority-consuming and majority-producing countries are key components of several company-wide strategies that intend to drastically reduce GHG emissions. At the consumer end of the value chain, some coffee corporations are transitioning their energy use in offices and retail spaces from non-renewable to renewable sources of energy, such as through the installation of solar panels. Coca-Cola, owner of Costa Coffee, for example, operates select stores that boast solar panels, and are strategically positioned to reduce energy consumption. Notably, while not an example of renewable

energy, the stores also focus on sustainable sourcing of certain materials, such as Forest Stewardship Council (FSC) timber.[36] This demonstrates the important intersection between improved sourcing and GHG emission reduction in strategy development.[37]

Beyond the introduction of solar power, other common office- and retail-associated actions include the introduction of energy-efficient LED lighting systems and the installation of charging ports for electric vehicles. The latter is also seen as a measure that encourages employees to reduce their own carbon footprint. On the producing end of the value chain, renewable energy has also been prioritized. For example, as previously noted, the company Caravela Coffee transitioned their dry mill in Colombia to solar power, and the panels are now said to provide approximately 81,621 kilowatt-hours (kWh) per year. The examples from both Coca-Cola and Caravela highlight a trend that emerged through the desk research, specifically that solar power appears to be the most widely adopted form of renewable energy for coffee actors to reduce their direct emissions and to replace fossil fuel-based sources of energy. Keurig Dr. Pepper is unique in their renewable energy investments in that the company opted for carbon offsetting via wind farms.[38] An initial purchase of carbon offsets from the Kansas Greensburg Wind Farm in 2009 later led the company to sign a multi-year contract in 2010, whereby they agreed to buy 50% of the farm's offsets for a duration of three years.[39] In 2019, the company announced their new "Drink Well. Do Good." corporate responsibility platform, which outlines multi-year goals related to the environment, health, supply chains, and community well-being. The platform includes plans to reduce fleet emissions and to obtain 100% of their electricity from renewable sources by 2025.[40]

Data Sharing and Accurate Accounting

Data sharing and accurate accounting remain key issues for the widespread adoption of effective carbon emission reduction strategies. A combined lack of peer-reviewed publications and publicly shared company data pertaining to emission rates of coffee enterprises creates difficulty in properly identifying emission hotspots across the value chain. While some retailers, traders, and roasters are working to publicly provide meaningful data about their GHG emissions and efforts to reduce these emissions, it is clear they frequently rely on different accounting methodologies and systems. This lack of consistency in data collection approach and methodology challenges actors across the supply chain from being able to comprehensively reduce their GHG emissions and compare footprint data and reduction targets. Furthermore, because the coffee industry is both international and segmented, an ongoing lack of consistent reporting methodologies will hinder successful collaboration and collective action going forward.

While each coffee stakeholder is in a unique position—depending on their distinct role in the market and supply chain—to develop and apply GHG

36 https://www.costa.co.uk/sustainability/climate.

37 Though rarely noted in the reviewed reports, the promotion of recycling or the use of more sustainable/upcycled materials is another important intersection to consider. It was beyond the scope of this project to understand why these strategies were less often mentioned in reports or even academic articles about GHG emission reduction, though the relevance of the intersection is worth mentioning here.

38 It is important to clarify that this decision was made in 2010 by Green Mountain Coffee Roasters, which was renamed Keurig Green Mountain in 2014, and later merged with Dr. Pepper Snapple Group in 2018, to become Keurig Dr. Pepper.

39 Green Mountain Coffee Roasters, Inc., "Corporate Social Responsibility Report Fiscal 2011,".

40 https://investors.keurigdrpepper.com/annual-reports.

reduction strategies, information sharing is critical to scale net-zero solutions or carbon neutrality, as is the availability of verifiable accounting methodologies.

Phase Three:
Survey Findings

About This Phase

Phases three and four of this research project were conducted simultaneously and focused on understanding the experience of many actors within the coffee industry and their efforts to reduce their GHG emissions. Such feedback was especially useful, as many of the public-facing reports reviewed were published several years ago, and referenced claims dating back over a decade. While this is typical in carbon reporting, as assessing a company's carbon footprint is an onerous task and therefore takes place infrequently, it doesn't provide clear guidance on current activities, especially for such an ever-adapting element of sustainability efforts. In total, 22 respondents completed the survey, representing traders, roasters, public sector organizations, civil society/non-profit organizations, advocacy organizations, and research institutions. These companies and organizations operate throughout the globe.

Key Findings

For survey respondents, GHG emission reduction is seen to be critically important, with many articulating a need for farm-level baselines before developing a strategy to achieve reductions. Notably, land-based interventions remain a primary focus of the actors surveyed, regardless of which tools and approaches they employ or what role they occupy in the value chain.

Generally, there was a lack of clarity about what actions will have the most impact—and which actions will allow stakeholders to meet their reduction targets. Although the use of carbon credits to offset emissions is an available opportunity when insetting targets are not met, offsetting appeared to be a less popular approach to reducing emissions among respondents. All respondents identified that limited knowledge, finance, and collaboration throughout the value chain are key barriers to the sector-wide scaling of efforts to reduce emissions.

Industry Perspectives

A Critically Important Issue

A significant majority of respondents, 77% in total, claimed that their company or organization is currently involved in activities and actions to reduce their overall carbon footprint or the carbon footprint of others, such as farmers in their supply chain. Unanimously, the main motivation behind engaging in these initiatives was the perceived need to ensure that global coffee production is preserved and maintained in the long-term, in cooperation with global partners. Notably, several respondents also commented that emission reduction is "the right thing to do," though this statement was not further elaborated.

In general, all respondents believed that achieving significant GHG emission reduction within the coffee value chain in the next few years was either important (27%) or very important (73%). In alignment with the findings from the desk review, a key first step before taking further action was the use of GHG accounting tools, especially at the farm level, to establish baselines and strategies. Among the respondents, one said, "We are currently investing in the capacity of coffee enterprises at origin to measure their carbon footprint; [the] next step will be determining reduction options." Meanwhile, others indicated that the lack of accessible carbon accounting tools, measurement frameworks, and data collection methodologies were challenges to setting goals to achieve meaningful improvements.

Preference for Land-Based Approaches

Respondents agreed that leveraging GHG accounting tools to establish baselines and meet future targets is important. Further data from the survey demonstrated that many actors are indeed taking steps to meet this goal, with 13 of 22 respondents (59%) stating that they apply some form of technology or digital tool to support their accounting. Given the particular interest in farm-level baselines, it is not surprising to see many companies are already using farm-related accounting systems, such as the Cool Farm Tool (67% of respondents claimed to be using this), remote sensing technologies, and/or other in-house designs.[41]

Regardless of the tools used, respondents noted that their company or organization was largely focused on (or interested in) GHG emission reduction via land-based and/or production-related interventions. In total, only 20% of the respondents claimed to have no emission reduction strategy at the level of cultivation or production, but these respondents were not as directly involved in farm-level or production work.

41 The Cool Farm Tool, which bills itself as an "online greenhouse gas, water, and biodiversity calculator for farming," has a perennials module which can be applied on coffee plots. The tool estimates emissions and sequestration levels per plot, based on land users' cultivation and production activities. Remote sensing, meanwhile, refers to satellite, drone, or aircraft technology that scans the above-ground biomass of specific properties to estimate that land's carbon emission and sequestration.

Among the respondents claiming to have farm- and production-level emission reduction strategies in place, efforts were focused primarily on the following: 1) reforestation and land conservation, including agroforestry; 2) improvements to wastewater management; 3) reduction or elimination of the use of certain fertilizers and pesticides; and 4) investments in solar and other renewable forms of energy (see Figure 2).[42] Of note, many respondents explained that their initiatives were in the very early stages of development. To move forward, they suggested it would be important to, first, better involve smallholder farmers in their efforts, and second, collaborate with cooperatives, civil society organizations, and other supply chain actors to reach scale.

42 Once again, efforts highlighting on-farm recycling or upcycling were notably absent from the responses. It was unclear whether this was not a key focus of various actors, one not often associated with GHG emission reduction strategies, or other.

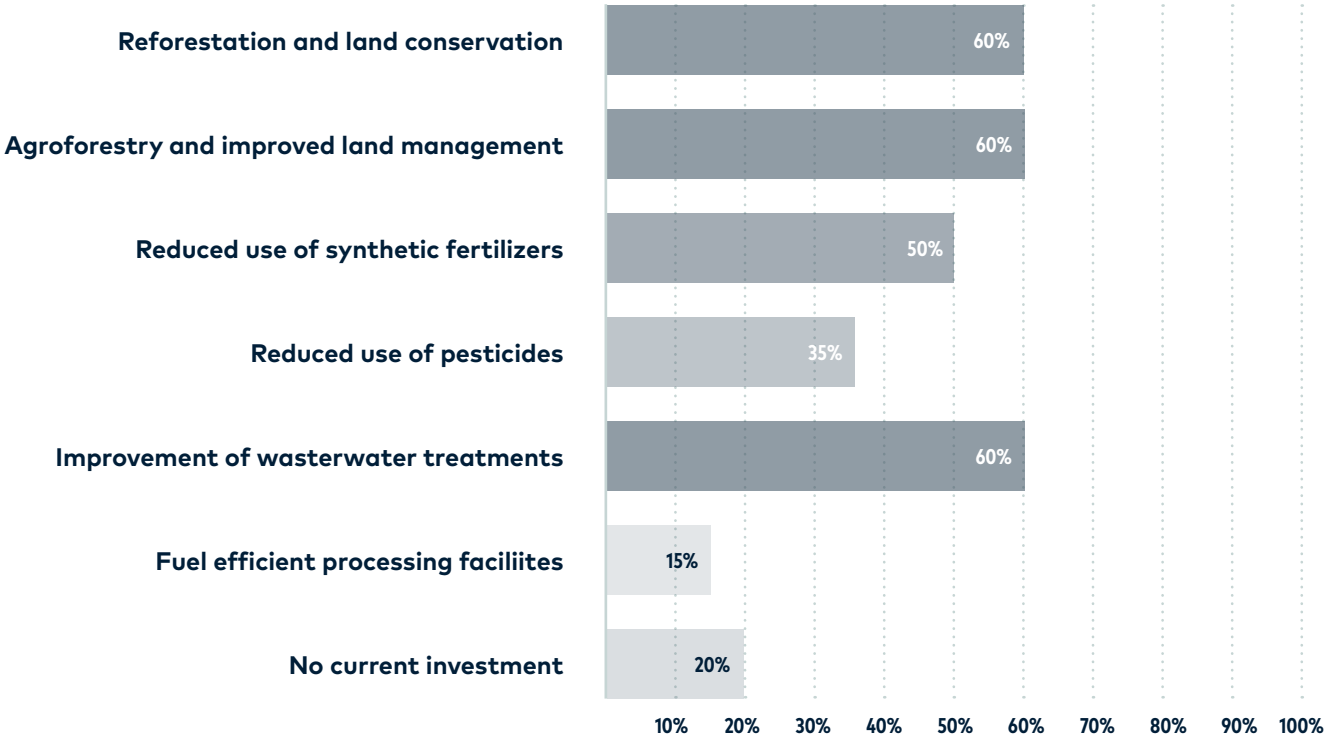

Figure 2. Self-reported actions and initiatives aimed at reducing GHG emissions at the levels of cultivation and production (respondents were allowed multiple answers)

Challenges Ahead

Lack of Clarity: Impact and Reduction

While emphasis is placed mostly on interventions at the levels of cultivation and production, according to the survey, respondents believe that the most demonstrable GHG emission reduction achievements have been associated with land conservation approaches and the adoption of energy-efficient or other footprint-reducing strategies in corporate offices and retail locations (see Figure 3). Such responses may reflect the fact that roasters made up 45% of survey respondents, and actors are more likely to understand their progress in areas over which they have more control and for which they maintain more accurate reporting. Indeed, energy efficiency would relate to Scopes 1 and 2, and often, energy use is reported separately alongside carbon footprints given specific clarity around what the data is able to show. For example, isolating energy-related data allows actors to demonstrate their decreased reliance on energy, even if such a dip in reliance does not have a major impact on their overall carbon footprint when accounting for all scopes.

Regardless of which interventions have the greatest impact, real or perceived, the majority of survey respondents also claimed that their company or organization has either not achieved their emission reduction targets (45%) or that they are unsure about their progress (27%). This is further indication that accurate and standardized methodologies to evaluate and reduce GHG emissions need to become more accessible if companies and organizations are to meet their goals in verifiable ways.

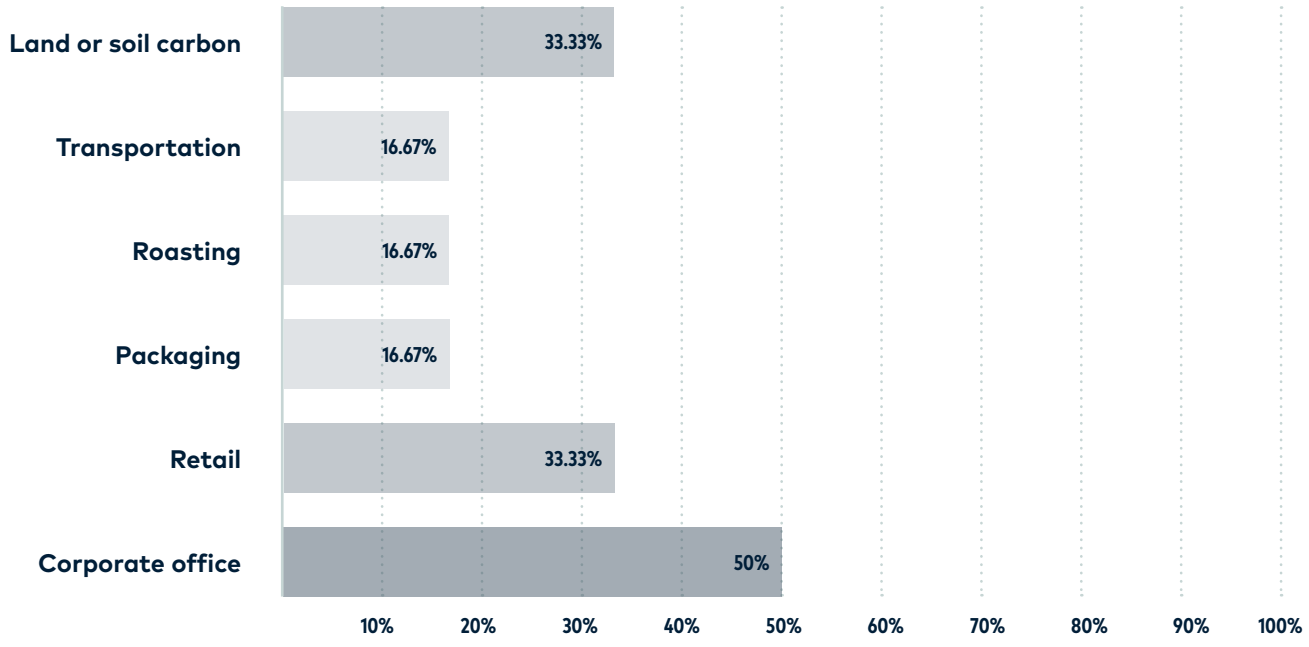

Figure 3. Actions and practices which have provided the greatest results (respondents were allowed multiple answers)

Underutilization of Offsetting

Although the desk research phase of this project revealed the significance and relevance of purchasing carbon credits (i.e., offsetting, when reduction and insetting are not possible), such expenditures did not appear widespread among the survey respondents. Only one-third of respondents said that carbon credit purchases were part of their strategies.
While the survey did not ask whether and why the focus on carbon credits has declined or increased over the years, it did ask respondents to describe which activities these credits tended to reference. Primarily, survey respondents claimed their companies and organizations focused on credits that related to CO_2eq capture from land restoration efforts, clean energy, and other community-based projects (see Figure 4). The reasons for these focuses were not thoroughly provided, but when asked about where the greatest potential for carbon offset exists when considering the entire coffee value chain, 80% of the respondents pointed to land and terrestrial carbon sequestration. The adoption of clean energy in retail spaces and corporate offices, as well as the reduction in emissions from transportation, came second. Notably, reference to "waste to energy" solutions were absent, potentially corroborating a lack of focus from the coffee and carbon industries on recycling and related activities.

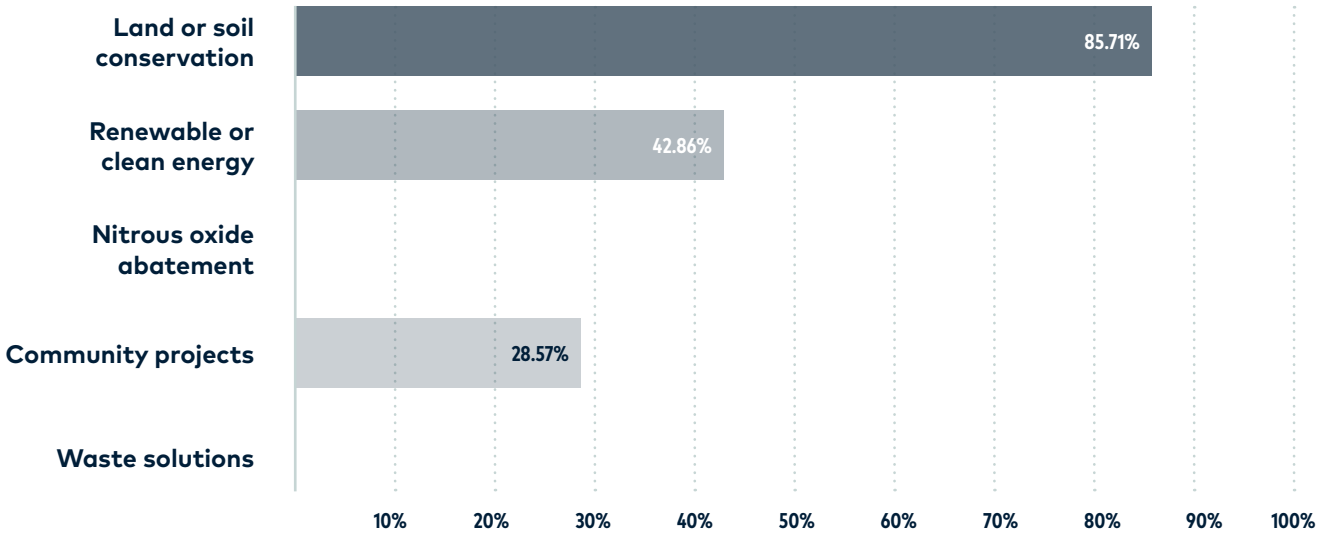

Figure 4. Offset areas that companies are investing in through the purchase of carbon credits (respondents were allowed multiple answers)

Significant Gaps

In consideration of the challenges that the entire coffee value chain experiences as it relates to GHG emission reduction, respondents pointed to limited knowledge or access to information, and a lack of incentives to make operational changes, as the two most predominant challenges. Lack of financing to invest in solutions and a lack of collaboration in the value stream were noted as secondary challenges (see Figure 5). As one respondent said, "Emissions assessments are time-consuming and costly. It can seem impossible [to achieve] and few businesses know where to begin."

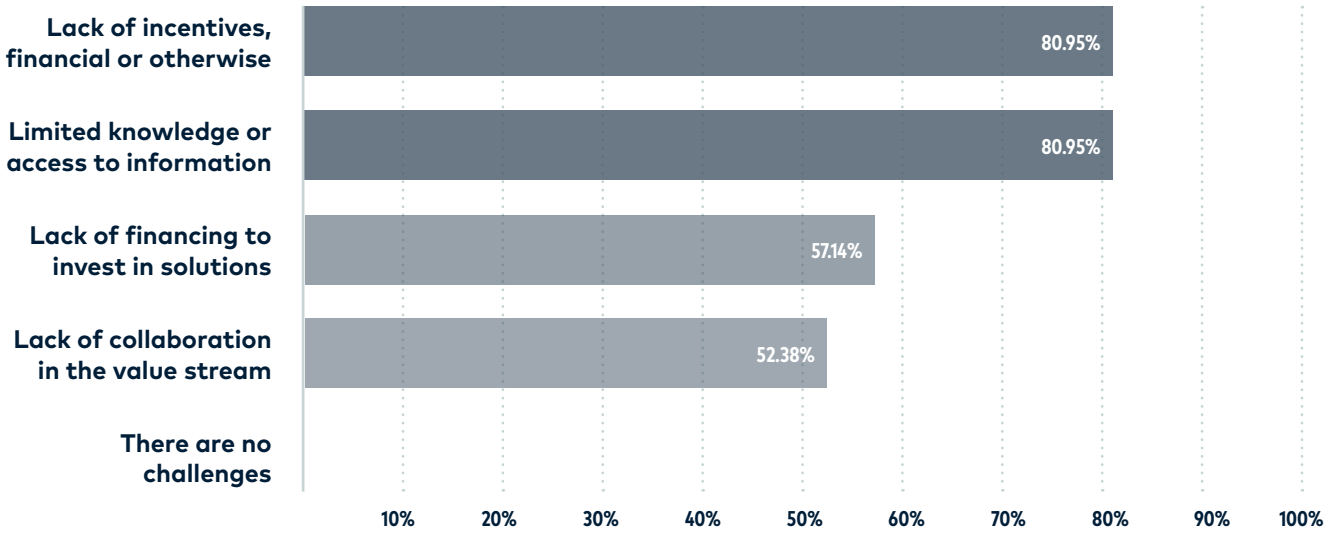

Figure 5. Perceived challenges for the industry when trying to engage in effective emission reduction strategies (respondents were allowed multiple answers)

Phase Four:
Interview Findings

About This Phase

Simultaneous to the third phase of this research project, phase four consisted of nine targeted interviews with select coffee traders, roasters, and retailers as well as with several environmentally focused non-governmental organizations. The interviews were conducted with the environmental sustainability managers, climate specialists or team leads, and/or CEOs of these participating companies and organizations. The goal of the interviews was to complement the desk and quantitative research on carbon emission reduction trends and gaps throughout the industry, and to add qualitative insight.

The companies and organizations interviewed shared the following characteristics: they operated globally and were relatively large in scale. The reasons for this selection were two-fold. First, the researchers wanted to interview companies and organizations that were of a similar size and scope to those reviewed during phase two, and second, we aimed to understand how coffee sector actors were currently accounting for GHG emissions across the entire value chain. While producer organizations and small companies do engage in robust emission reduction, findings from the desk review phase suggested that the former focus their efforts almost exclusively at the levels of cultivation and production, while the latter face greater logistical and financial challenges in verifying their accounting and reporting when compared to large companies.

Key Findings

Like the survey respondents, interviewees identified that the existing lack of standardization has led to limited important baseline data, benchmarking, and comparative analysis. Although the interviewees are interested in focusing on emission hotspots, the lack of standardization also means they struggle to accurately quantify their Scope 3 emissions.

Critically, interviewees identified the relationship between industry/consumer demand for GHG reduction, and related financing for farmers to meet these demands. Specifically, without targeted financing, the gap between these demands and famers' capacity to meet them will remain. One approach—which is of increasing interest to many coffee industry actors—is payment to farmers for ecosystem services, such as carbon sequestration.

Existing Challenges

Lack of Standardization Leads to Further Issues

Similar to phase three findings, the majority of interview respondents, both organizations and companies, noted that the lack of standardized methodologies in assessing GHG emissions across the value chain poses a significant challenge to setting and meeting reduction targets in a timely fashion.

First, without standardized methodologies, there is a lack of widely agreed-upon benchmarks or baselines from which to improve. Respondents noted that understanding their company's baseline of GHG emissions is critical before any actionable strategy aimed at reducing those emissions can be put into place. Even the companies that have begun to account for their GHG emissions lament the lack of standardization, as it was suggested that this leads to diverse means of accounting and effectively makes company-to-company data incomparable. Many respondents voiced concerns regarding the risks of comparing climate work or percentages of GHG emissions from company to company without additional contextual analysis related to accounting tools, boundaries, and models.

Difficulty of Quantifying Scope 3 Emissions

Company interview respondents appeared to be deeply invested in measuring their carbon footprint and in locating carbon emission hotspots within their operations. Reliance on the GHGP was widespread among the companies interviewed. While respondents noted that direct emissions under Scope 1 of the GHGP, and indirect emissions related to energy use as defined in Scope 2, are relatively easy to account for—as they fall under a company's control—it was acknowledged that Scope 3 accounting was particularly challenging. For roasters and traders alike, Scope 3 emissions frequently constitute, among other categories, those at the level of cultivation and production. As previously noted, accurate and standardized accounting at these levels is lacking, making Scope 3-related GHG emissions difficult to comprehensively quantify and therefore reduce.[43]

Despite the difficulty, many respondents considered Scope 3 accounting especially important and useful for companies to assess should they want to make meaningful claims regarding emission reduction in the future–given the total percentage of GHG emissions that can be categorized under this scope. To put this into context, a couple of company respondents suggested that up to 85% or 90% of their emissions are classified as Scope 3.

43 While the standardization of accounting methodologies remains a work in progress at the levels of cultivation and production, interview respondents expressed the importance of continuing to incentivize and support farmers to implement agroforestry and diversification efforts now. Indeed, though the tools to accurately and exactly quantify the emission reduction that results from the application of these best agricultural practices are still in development, the benefits of the practices are well-known for both CO_2eq reduction and productivity increase.

Looking Ahead

A Need for Targeted Financing

When asked to elaborate on their emission reduction strategies and use of carbon footprint accounting tools, several interviewees noted first and foremost the importance of building strategies—and confirming tools for use—that are based on the educational and financial realities and needs of suppliers. Smallholder farmers constitute the majority of coffee producers and suppliers, and as a result of many factors, they have limited financial capacity to apply ongoing sustainable farming practices that would lead to emission reduction or carbon sequestration on their farms and beyond.

One interviewee, for example, stated that their company's interest was to focus on the financial well-being of smallholder coffee growers alongside any and all of their environmental efforts. They saw this as essential and suggested that some demands and calls for environmental protection—especially from the consuming side of the value chain—neglect to understand the social and economic consequences of climate change, and/or the social and economic implications of solutions. It was noted that environmentally focused programs must also therefore adequately ensure the simultaneous socio-economic stability of farmers if they are to be successful. This includes ensuring that climate solutions at the level of cultivation and production are accompanied by proper technical support and living income guarantees. Without such efforts, interviewees agreed that coffee farmers would not have the necessary capacity or external financial incentives to invest in long-term climate solutions.

In addition, respondents noted that access to GHG emission assessment tools needs to be expanded for farmers in order for them to estimate and improve—in collaboration with other industry actors—the environmental impact of their current agricultural practices.

Payment for Ecosystem Services

At present, certifications like Rainforest Alliance, Fairtrade International, Organic, and CAFE Practices do not require GHG accounting and reporting, nor do they mandate carbon neutrality, net zero goals, or specific rates of emissions or sequestration. However, many industry actors are demonstrating interest in providing voluntary (i.e., non-certification-related) payment for ecosystem services as an alternative income source for farmers and contribution to living income. Examples of ecosystem services, defined as benefits that humans receive thanks to natural environments, include clean water (via treatment facilities and conserved forests) as well as food provision and soil health (through biodiversity and carbon sequestration). Of note, while agriculture contributes to GHG emissions, the extent of this contribution depends on farming system,

and, through improved practices, emissions can be offset—constituting an ecosystem service.

It is clear that soil carbon storage counts as an ecosystem service. Companies predict that if they can pay farmers for their carbon sequestration, they will both reward farmers for their climate-smart best agricultural practices and establish an additional way to drive more funding to producers. As most interviewees mentioned the need to better assist or incentivize farmers in applying more sustainable or carbon-smart farming practices, payment for services is viewed as a way to fill the incentive gap. Such payment can also set companies apart from their competitors, and may rapidly become a key element of marketing schemes going forward.

Conclusion: **Recommendations and Case Studies**

While the desk research as well as the survey and interview findings from this project pointed to the many challenges inherent to GHG accounting and reduction in agriculture, study respondents and experts alike agree that engaging in carbon emission reduction is a non-negotiable requirement for the coffee industry going forward. Without it, future production cannot be guaranteed.

This paper intended to shed light on the efforts currently underway in the coffee industry to a) quantify and reduce GHG emissions throughout the value chain; b) meet sustainability and emission reduction targets; and c) keep farmer livelihoods at the center of the conversation. The research team hoped that, through a combination of desk research, surveys, and interviews, it would be possible to identify key focal points and gaps in the industry's understanding of carbon and identify best practices currently in use. As the strategies reviewed throughout the research process were employed by actors of all different shapes and sizes, it was also our hope to provide practical recommendations for all coffee businesses interested in reducing their own emissions.

While these aims were partially met, the research revealed that gaps in knowledge and action do still remain, both within the literature and among coffee industry actors. These gaps relate to larger, cross-sector challenges which limit collective understanding and the standardization and adoption of more emission reduction techniques and reporting worldwide. Though there is an important amount of work and investment taking place to curb GHG emissions, the coffee industry is just beginning to understand its capacity to mitigate climate change through carbon-based efforts, both inside and outside of the carbon market. The fact that gaps do remain does not diminish the importance of the efforts currently underway, nor the preliminary findings in this report.

Finally, for the industry to continue to make progress in measuring and reducing GHG emissions, as well as in sequestering carbon (and valuing sequestration), coffee industry actors will need to work collectively as well as individually. As companies seek to measure and mitigate their footprints, they should also share their practices and work with their peers to develop a common understanding of how to measure GHG emissions in the coffee value chain, and discuss what kind of mitigation strategies are most effective. Meanwhile, coffee farmers share an inherent vulnerability to climate change, but their needs and abilities to adapt and to engage in GHG emission reduction differ depending on numerous factors, from farm size to farming system to resource access. While it is clear that progress will continue, we hope that by clarifying points of common confusion and offering case studies on work being done to date, we can help to accelerate the pace of progress through this report.

Recommendations

> *In light of the report's findings, the following recommendations are offered. Of note, many are broad and require a forward-looking and collaborative mindset rather than a strict focus on perfecting best practice. They also require partnership outside of the coffee sector, as a number of carbon-related strategies are currently being tested for scale across regions, products, and contexts. As the carbon market itself is an ever-changing commodity market that will change and adapt over time, just as the coffee market itself will do, it is important that all industry actors keep abreast of alterations and reorientations.*

Invest in the development of shared and universally-accepted GHG tracking and accounting systems for the coffee industry, ensuring their adaptability to various contexts.

Share GHG tracking and accounting systems throughout the coffee industry to a) allow for comparability; b) demonstrate best practice for policymaking; and c) support the development of company-wide or organizational reduction strategies.

Rely on existing tools and models to establish baselines for GHG emission within companies or organizations to develop future targets and a clear roadmap for carbon footprint reduction, insetting, and offsetting.

Consider investing in carbon credits to meet carbon neutral targets while also working substantially to reduce emissions among all three scopes—this includes insetting within one's own supply chain.

Champion research and pilot projects focused on improving emission reduction strategies related to all types of transportation.

Improve awareness among a diversity of actors about the distinctions between Scopes 1-3, their related accounting methodologies to date, and their suggested strategies for reduction.

Maintain focus on renewable energy at all levels of the value chain, and consider further conversation about the role of sustainable materials and upcycling.

Directly invest in the capacity of producers and producer organizations to measure and reduce their carbon footprint over time, ensuring they maintain ownership over the process in the long-term.

Ensure that producers are continually incentivized to take action toward carbon and other emission reduction by maintaining focus on living income, supply chain profitability, and on-farm productivity.

Prioritize information sharing and pre-competitive collaboration in all activities and efforts related to the above.

Case Studies

San Francisco Bay Coffee

San Francisco Bay Coffee, a family-owned roasting company founded in 1979, understands the importance of continuing to assess their GHG emissions and to keep track of their achievements. As their company evolves, so do their carbon emission reduction targets. They have noted that reliance on carbon and GHG accounting tools is critical to identifying emission hotspots and to developing emission reduction targets.

QUICK FACTS

- First carbon footprint assessment: 2007
- Next carbon footprint assessment: 2022
- Goal: Becoming a Carbon Neutral or Carbon Negative Company
- Certification sought through Enveritas and UL (Underwriters Laboratories) Solutions Zero Waste

SPECIFIC EFFORTS

Farm Level
San Francisco Bay Coffee is vertically integrated, and owns approximately 2,800 acres in Hawaii (Kona), Mexico, and Panama. There, they experiment with coffee varieties and assess the on-farm potential for carbon sequestration and the activities that will lead to resilience to climate change. The company is in the process of certifying their acreage as carbon sequestering sites to help offset the overall CO_2 that will always be produced as a result of their business. One example of such an effort aimed at reducing CO_2eq output is a more targeted fertilization regime that reduces the reliance on tractors and minimizes fertilizer use.

At the Roasting Facility
San Francisco Bay Coffee is currently researching electric roasting to reduce the amount of natural gas burned at their facilities during the coffee roasting process. Roasting is the company's main activity and, based on their 2007 carbon footprint assessment, accounts for 42% of their overall carbon emissions. Since becoming aware of this figure, they have invested in an afterburner to reduce the amount of impurities emitted into the atmosphere. They have also invested in ways to make their roasting machines more efficient through a gas delivery system, which saves approximately 30% of natural gas.

Travel
Travel policies have been put in place by the company to reduce travel that is not completely necessary. San Francisco Bay Coffee has also implemented more peer-to-peer networking tools like ZOOM and Microsoft Teams to ensure remote conversation and collaboration, alleviating the need for travel for in-person meetings. It is now in their strategic plan to install electric car charging ports to entice employees to switch to electric vehicles.

Corporate Building
The company has already replaced all of their incandescent bulbs with LED lights to reduce electricity usage. There is also a 1000 kW system of 4008 solar panels on the roof of their headquarters, which supplies approximately 60% of the company's electrical needs. Currently, San Francisco Bay Coffee is looking into installing more panels and battery storage so that there is no need to send the power to and from the grid before use.

Waste Generation
San Francisco Bay Coffee is Zero Waste certified by Underwriter Labs at 94% diversion from landfill. This means that 94% of all their waste is either composted, recycled, or reused. Of note, the company does not incinerate anything, though some Zero Waste programs do allow for this. In 2016, the company went from 500 tons of waste going to landfills (80% of their total waste) to approximately 30 tons in 2021 (just 6% of their total waste). This effort took multiple years of work, collaboration with suppliers to change or reduce their packaging materials, and updates to the material used in their factories. Now, they have set new goals to reduce waste even further, an additional 1% reduction per year. While the company hasn't translated these values into CO_2eq, it is well documented that diversion from landfill leads to emission reduction.

Packaging
Making all of San Francisco Bay Coffee's packaging compostable is a major present focus for the Research and Development (R&D) department, and for the company as a whole. They are currently in the final stages of ensuring the material which makes up the bags of coffee that consumers purchase are in a home compostable state. Their "OneCUPs" are already industrial compostable, and they are very close to making these items home compostable as well.

Acorn/Rabobank

Rabobank is a cooperative bank and financial services provider that focuses their global efforts on the food and agriculture industries. Acorn is the bank's response to climate change and promotes agroforestry in the coffee sector and beyond. By measuring yearly above-ground carbon sequestration on coffee plots via scalable, low-cost, remote sensing technology, Acorn is able to verify and certify carbon removals (i.e., sequestration) from tree cover through a third-party auditor. The carbon-smart farming practices that are behind these carbon removals have recently been generating high quality credits in the voluntary carbon market (VCM),[44] thanks to Acorn's innovative remote sensing and certification solutions.

QUICK FACTS

- Credits sold at €20 per ton CO_2eq through the VCM since 2020
- System relies on accounting structures approved by the VCM
- The system's measurement, reporting, and validating (MRV) service is a fraction of the MRV costs when verification is done by traders themselves (€50+ per yearly visit to a farm vs. €20,000 to certify a company project individually)

SPECIFIC EFFORTS

Confirmation and Payment for Carbon Removal Units
Acorn connects smallholder farmers to large corporations who want to offset their emissions. Participating companies get highly detailed data on the carbon removal rates and practices of participating farmers, and the farmers do not have to invest onerous amounts of money on MRV. For the past two years, the carbon removal units (CRUs) that have been verified through Acorn have been selling at a minimum value of €20 per ton of CO_2eq on the VCM. Of this €20 per ton, 80% goes to the participating farmer, 10% to the local implementing partner (e.g., an organization, company or farmer association that supports data collection), and 10% to Acorn for management purposes.[45]

Encouraging Annual Accounting and Trader Payment for Farmers' Eco-System Services
Taking the yearly VCM carbon price as a benchmark value for Scope 3 removals going forward, Acorn now aims to help more coffee traders account for removals in their annual reporting and compensate farmers in their supply chain for their successful carbon farming practices year over year. This is possible because carbon is gradually sequestered by coffee farmers as their shade and other trees grow. If such growth is effectively measured, farmers can get paid through Acorn each year for the additional growth of their trees. Since implementing above-ground carbon-smart

44 The Voluntary Carbon Market (VCM) functions separately from the mandatory market. The mandatory market arose to support companies and governments as they met legal offset requirements prescribed by the Kyoto Protocol. The VCM allows companies to purchase verified carbon offsets on a voluntary basis (i.e., they are not legally required to do so). The mandatory carbon market, meanwhile, is regulated by internationally, regionally, and nationally recognized compliance schemes, such as the first-of-its-kind Clean Development Mechanism, the California Carbon Market, and the European Emissions Trading Scheme (EU-ETS).

45 The 10% to Acorn covers the following: remote sensing of the sequestered carbon, third party verification of the CRUs, certification of the CRUs, selling the CRUs to buyers, the saving of data on Acorn's registry, overhead, and profit for scale.

farming practices requires continuous labor and additional costs, these yearly payments are key to ensuring full support for farmers as they maintain ongoing carbon sequestration. In addition, by contributing to carbon-smart farming systems with traceable payment, traders can claim a causal relationship to the carbon removal of their suppliers.

Allowing for Transparency and Data Sharing Among Traders
Through Acorn, farmers and traders follow the same accounting structures as the VCM and the mandatory market/national compliance schemes. This provides a solid structure for both accounting and monetizing removals, and it allows traders to compare their carbon removal efforts against other claims. In particular, companies making claims from the same supply streams can compare their data in order to avoid double claiming, which provides an additional element of verification and quality control. Likewise, sharing practical commitments and achievements illustrates the success of sustainability efforts throughout the supply chain, and can support others to set their own targets for tracking and increasing land-based carbon sequestration.

Investing in Transitions to Carbon-Farming
In cases where farmers are already sequestering carbon, they can be paid in cash for their removals. In cases where farmers are looking to make a transition to carbon-smart farming in order to receive payments for their eco-system services in the future, traders may invest in this transition. The investment can then be repaid once the farmer is able to receive cash for carbon removals on their land (i.e., once they are able to sell CRUs as an additional product/form of income, separate from coffee). This means that traders do not have to compensate for their investments through cost-cutting elsewhere or by lowering the price they pay for coffee. Furthermore, because Acorn's MRV service is a fraction of the MRV costs should traders attempt to verify carbon capture themselves, more money can be invested in farming practices themselves or in supporting supply chain partners to achieve greater sequestration. Acorn's MRV is also of high quality, allowing for greater consumer trust in claims made by traders.

Cooperative Coffees

Cooperative Coffees is an importing cooperative of Fair Trade and Organic coffee committed to improving the livelihood of small-scale coffee farmers, providing services to their 23 roaster members, and creating connections that have a regenerative and sustainable impact. They prioritize long-term relationships with farmer cooperatives and believe that coffee can contribute significantly to climate mitigation. For Cooperative Coffees, this means investing in the capacity of small-scale producers to regenerate soils, promote organic practices, and diversify their farms—among other efforts. It also means making sure roasters are doing their part.

QUICK FACTS

- Impact fund created: 2015
- Roasters' contribution: US$0.03/lb. of green coffee purchased
- Investments to date: US$900,000 (much of this going to climate work at the producer level)
- First carbon footprint assessment of roaster members: 2017
- Goal: Carbon neutrality by 2025

SPECIFIC EFFORTS

Impact Fund
The Impact Fund supports carbon sequestering agricultural practices as well as other innovative projects in producer communities. It contributes to the health of people and soils and to producer-led sustainable development. In response to the COVID-19 emergency, for example, the Cooperative Coffees Board of Directors approved an emergency allocation of US$130,000 to support producer partners' response to food scarcity and basic hygiene needs. Currently, up to 60% of Impact Fund resources are allocated to provide voluntary premiums to farmers for their soil carbon sequestration. The remainder continues to fund producer-led projects, many of which include reforestation and other climate-positive initiatives.

Measuring the Carbon Footprint of Roaster Members
Cooperative Coffees continues to adapt and improve a Carbon Calculator to account for roaster emissions based on the most relevant data available. Emission categories include coffee importation from port-to-port, with a focus on travel, storage, and warehousing; staff travel to and from work; inbound and outbound shipping of coffee from port to consumer, including emissions from warehousing; facility emissions from manufacturing, roasting, and packaging; air travel for business; and company-owned vehicle emissions. Notably, roasters can customize their answers in many categories; for example, they may choose their actual energy provider and calculate emissions based on data from the specific utility company in their area. The tool also allows roasters to enter

importation data for purchases from other traders to understand their total carbon footprint.

Cool Farm Tool Project

In 2020, Cooperative Coffees launched a three-year project with Root Capital, Sustainable Food Lab, The Chain Collaborative, and producer cooperatives CENFROCAFE, CAC Pangoa, COMSA, Manos Campesinas, Norandino, and Sol & Cafe. Funded by the InterAmerican Development Bank, the project seeks to adapt and customize the existing perennials module of the Cool Farm Tool to smallholder coffee farms. To date, over 250 farmers across Peru, Guatemala, and Honduras have applied the tool to measure the carbon capture and emission of their plots and production, and have supported project team members to update question and answer fields so that they are more responsive to coffee systems. Results demonstrate that small-scale, organic coffee production, when managed as an agroforestry system and under the best agro-ecological practices, is able to sequester carbon and provide related ecosystem services. Through this project, Cooperative Coffees plans to support the scaled use of the adapted perennials module of the Cool Farm Tool. Ultimately, this should lead to greater benefits for coffee farmers by enabling producers and cooperatives to demonstrate verified environmental services at the negotiation table with all their customers throughout the industry.

Recognizing Carbon Capture in Coffee Contracts

The goals of the above project and tracking carbon sequestration on individual farmer plots using the Cool Farm Tool are manifold. First, Cooperative Coffees and their project partners aim to showcase a set of regenerative practices that are at once most effective for carbon capture and also lead to increased farm health and crop productivity. Second, they aim to support farmers and cooperatives in being able to identify opportunities for improvement in the application of best agro-ecological practices. Third, they plan to assess sequestration rates and establish a model for environmental service premiums built into coffee trade contracts to pay farmers for their carbon storage. Through this effort, they hope to inspire others to track their carbon footprint from seed-to-cup and compensate farmers for their regenerative practices already in place, while also providing data that will enable increased carbon sequestration over time.

Solidaridad

Solidaridad is a non-governmental organization that has been working since its foundation in the 1980s with the coffee sector when it co-initiated the first voluntary standards for sustainability: first, Max Haavelar, and second, Utz certified (now merged with Rainforest Alliance). Since then, Solidaridad has continued to work on key sustainability issues for the coffee value chain, generating relevant knowledge and testing innovative solutions, such as "Low-Carbon Agriculture." The organization believes the key to their success, in this solution and others, is working with producers in the field via local staff of producer organizations and buyers, who are deeply rooted in the communities they serve. This model generates a better understanding of projects and guarantees quality and local ownership of program activities, including Solidaridad's technical assistance services.

QUICK FACTS

As a result of the scale of Solidaridad's Low-Carbon Agriculture (hereafter, LC-Ag[46]) program, which was first designed in 2013, the organization has achieved the following results. These figures include data from coffee farmers who have participated in the LC-Ag program, though the program also works with the following value chains: cocoa, tea, yerba mate, and livestock.

- Emissions per hectare reduced by 2,463 kgs of CO_2eq (44% emission reduction) and by 2.9 kgs of CO_2eq per kg of coffee (49% emission reduction) on average
- Producers increased income by 70% and productivity by 10% on average with the implementation of LC-Ag practices
- 52,446 hectares transformed into Low-Carbon Agriculture
- 14,821 producers adopting LC-Ag practices
- 5,213 hectares of deforestation avoided
- 2,257,151 metric tons of CO_2eq emissions avoided
- 49,541 metric tons of CO_2eq sequestered

SPECIFIC EFFORTS

Technical Assistance for Low-Carbon Agriculture
Since 2013, Solidaridad has supported coffee farmers in their transformation towards what the organization terms "Low-Carbon Agriculture" (LC-Ag). LC-Ag includes a set of five practices for coffee systems: 1) introduction or management of agroforestry systems (shade management); 2) soil conservation; 3) optimization of tree density; 4) fertilization management; and 5) management of by-products (e.g., processing wastewater and producing compost). The process to transition coffee farmers to LC-Ag features a scheme of technical assistance, provided by local field staff that is hired by Solidaridad and

46 Although Solidaridad refers to their Low-Carbon Agriculture as the abbreviation "LCA," this report uses "LCA" in reference to a "Life Cycle Analysis/Assessment," so a different abbreviation is used here, only for this report.

project partners, which further reinforces the capacities of project partner staff to align with the model. The model includes initial training as well as follow-up field visits, both collective and individual. Additionally, the model promotes a Farmer Leader's approach in which Solidaridad provides additional support and knowledge to lead producers and contributes to the establishment of mechanisms that will enable them to continually share knowledge with other community members. While support for an LC-Ag transition is initially offered by Solidaridad, jointly with local cooperatives and companies who are sourcing in the area, the organization strives to generate gradual internal adoption of the LC-Ag approach and practices. This allows LC-Ag-encouraged activities to be incorporated into existing ways of working among cooperatives and other enterprises, and further emphasizes the need for a train-the-trainer approach.

Increasing Emissions Before Decreasing to Support Long-Term Farmer Profitability

Producers who boast low-intensity agricultural systems and initiate an LC-Ag journey normally have only basic specialization in their crop and adopt a limited use of inputs. This often results in fewer GHG emissions overall, but productivity and profitability are prohibitively low. By engaging in the LC-Ag program and following the recommended practices, low-intensity producers have seen their emissions increase by 494 kgs of CO_2eq per hectare (a 70% increase on average) and by 0.3 kgs of CO_2eq per kilogram of coffee (a 30% increase on average) in the short term. While this may seem counterintuitive for a low-carbon approach, the reason for its promotion is that productivity is expected to increase after the adoption of LC-Ag practices. These increases may require a 2-3-year cycle before results are shown, but as productivity increases and more LC-Ag practices are adopted, emissions per kg of coffee and by hectare are then reduced. On-farm deforestation tends to reduce as well, resulting in a more productive farm with lower environmental impact. In addition, and just as important, resilience and adaptation to climate change increases, ensuring producers are more likely to stay on their existing and productive land, and prevent the displacement of current coffee production areas.

Managing the Intersection Between Productivity and Emission Reduction

Producers with high-intensity coffee production systems who already implement some LC-Ag-recommended practices are still eligible to engage in the LC-Ag program, as they can aim to improve their efforts or apply more of the suggested practices. In such cases, lower emission rates and high productivity levels have been achieved as a result of better management practices. Where there is exemplary productivity and emission abatement with high-intensity farmers, it is important to consider how best to share their data. For example, when calculating emissions per hectare, versus emissions per kg of coffee, the same data inputs can lead to different emission scenarios. For farmers with higher production, for instance, emissions have been reduced on average by 8,870 kgs of CO_2eq per hectare (66% decrease) as a result of ongoing LC-Ag implementation. Meanwhile, when calculated per kg of coffee, emissions have been reduced on average by 5.6 kgs of CO_2eq (60% decrease).

Overcoming Market Bottlenecks

The main bottleneck in the transformation to LC-Ag is the lack of market incentives. While producers regularly invest in change and on-farm improvements, the market recognizes their efforts to only a limited degree. For this reason, Solidaridad led a market assessment before launching the LC-Ag program to understand the industry appetite for low-carbon coffee. They found a moderate interest that could grow or be consolidated over time as sector requirements around GHG reporting and emission reduction became clearer. There were, however, a few front-runners and forward-thinking companies that invested in and sourced LC-Ag coffee. Because interest was still moderate, only 1,753 metric tons of LC-Ag coffee (approximately 3% of the total LC-Ag production created by the participants of the project during its pilot period) were sourced as such between 2019 and 2021 by Finlays, RGC, and ofi (formerly Olam Coffee). Additionally, some companies invested in the model even when it was not connected to their sourcing (Finlays and a fourth international company). Currently, Solidaridad's LC-Ag model is attracting more interested companies as Scope 3 and deforestation-free strategies are increasingly required by the sector.

Glossary

Afforestation. The planting of new trees or forests on lands which historically have not been previously forested.

Artificial Intelligence. The ability of a machine to simulate human intelligence, or of an object to be controlled by a computer, in order for it to conduct certain tasks that are normally completed by humans.

Carbon Footprint. Total GHG emissions (of a product, business, or other entity) expressed in CO_2eq.

Carbon Neutrality. When there is a net contribution of zero CO_2 to the atmosphere, as any amount of CO_2 being emitted is subsequently being compensated by reductions or removals (refers only to carbon). Entities who emit more carbon and/or CO_2eq than they remove are sometimes referred to as "carbon positive," or even "net positive" for short (although the latter phrase does not always reference carbon or other GHG emissions). Entities who emit less carbon and/or CO_2eq than they remove are conversely referred to by some as "carbon negative."

Carbon Removal. Carbon removal, or carbon dioxide removal, occurs when CO_2 is captured or removed from the atmosphere and sequestered for an extensive period of time. This can happen naturally, or by technological design.

CO_2eq. Carbon dioxide equivalent, which converts the environmental impact of one ton of various GHG into their equivalents in CO_2 based on a common denominator of each gas' global warming potential (GWP).

Emission Hotspots. Areas or activities identified as generating or releasing a disproportionately high amount of GHG into the atmosphere, producing elevated risks.

Greenhouse Gasses (GHG). Gasses that trap heat in the atmosphere and warm the surface of the planet.

Global Warming Potential (GWP). The heat absorbed by any GHG in the atmosphere as related to the heat that would be absorbed by the same amount of carbon dioxide, over the same period of time.

Greenhouse Gas Protocol (GHGP). An international GHG emission standard for the public and private sectors, co-developed by the World Resources Institute and the World Business Council for Sustainable Development.

Home Compostable. Something that can be composted via a longer, lower-temperature process and conducted in a home setting (home-

compostable packaging, for example, can be placed in a home compost bin alongside other organic waste; anything on the package, such as ink, can decompose).

Industrial Compostable. Something that requires a faster, higher-temperature process of composting in a controlled industrial setting in order to break down.

Insetting (of Carbon). The implementation of actions or activities like those related to reforestation, renewable energy, and regenerative agriculture, to reduce emissions of GHG. Carbon insetting usually refers to reductions made within one's own value chain, but can also lead to removals.

Life Cycle Analysis (LCA). Also known as "Life Cycle Assessment." A measure of the total environmental impact of a product's life cycle from cradle-to-grave, or from raw materials acquisition up to production, use, and final disposal.

Net Zero. A state in which all the GHG going into the atmosphere (emission sources) are balanced by removal of GHG out of the atmosphere (emission sinks) in the long-term, called for by the Paris Agreement. Net zero considers the goal to keep global warming under 1.5 degrees Celsius. For more information, visit https://netzeroclimate.org/what-is-net-zero/.

Offsetting (of Carbon). An action or activity to reduce or remove emissions of carbon dioxide or other GHG from the atmosphere in order to compensate for emissions made elsewhere.

Reforestation. The planting of new trees or forests on lands that have been deforested, or in areas where tree cover has been decreasing.

Regenerative (Agricultural) Practices. An approach to land management that relies on practices such as no-till, cover cropping, crop rotation, etc., with the goal to reinstate and maintain balance among all components of the environment and to improve soil quality, plant nutrition, and soil carbon sequestration.

Remote Sensing. Satellite, drone, or aircraft technology allowing for the scanning of properties on the earth's surface and the obtaining of information related to its features (e.g., vegetation).

Satellite Imagery. Images captured remotely via satellite technology.

Value Chain. The full scope of activities, from start to finish, needed to create and deliver a service or product to final consumers.

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