Info Note

Brewing resilience for Ethiopia's smallholder coffee farmers

A closer look at Ethiopia's coffee sector to help address climate information gaps

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Key messages

- Low profitability and increasing climate variability and change represent the most significant threats to coffee production in Ethiopia.
- Research and solutions to date have focused on the impacts of climate variability and change on coffee production at a macro global level, to the detriment of local scales where such information is most needed for decision-making.
- Actionable, tailored advisories at the coffee farm level for sustaining income in an uncertain climate are unavailable, leaving smallholders ill-prepared to manage and adapt to such changes.
- About half of interventions targeting Ethiopia's coffee value chain address climate in some way. However, less than 6% of these interventions work to promote climate adaptation through the provision of climate services to inform decision-making at the coffee farm level.

A powerhouse in coffee production—Africa's largest—and a place where more than 15 million people rely on the sector for their livelihoods (Petit 2007), Ethiopia is the world's fifth-largest exporter of *Arabica* coffee (Moat et al. 2017), a product that represents 34% of the nation's total export earnings (USDA 2019). Considering 70% of the total coffee traded in the world is *Arabica*, it is no surprise that 100% of Ethiopian coffee production is of this species (Kew & ECFF 2017). What is more, the country is considered the center of origin and genetic diversity of *Arabica* coffee (ECFF 2015). Although this species has a relatively high market value due to its exceptional quality, its production is, nonetheless, extremely sensitive to climate variability (Davis et al. 2012). It is estimated that by the end of the century climate could render 39-59% of Ethiopia's coffee-growing areas unsuitable for cultivation (Moat et al. 2017).

In terms of production, smallholder farmers account for an estimated 95% of coffee production in Ethiopia (Petit 2007), representing 4 million farms. As for farming systems, these are diverse. Researchers have identified four main categories: forest coffee, semi-forest coffee, garden coffee, and semi-modern plantation; the last one referring exclusively to public plantations and those owned by private companies (ECFF 2015). Smallholder farmers usually practice the first three production systems, characterized by being rainfed, having low levels of investment – limited use of fertilizers, pesticides, and herbicides – and consequently, obtaining low yields averaging 0.64 tons per hectare in "*Meher*" season (Tadesse et al. 2020). Such rudimentary farming systems do not have the resources to cope with climate variability, including climate extremes such as drought. While coffee gardens are widespread across the country in the southern, eastern, and southwestern parts, forest coffee is found in the southeastern and southwestern parts of the country, and semi-forest coffee is prevalent mainly in southwestern Ethiopia and in the Bale Mountains of the southeast area. On the other hand, large plantations are located in the zones of Arsi, Bench-Maji, Gambella, Jimma, and Sheka (ECFF 2015).

Smallholders' investment limitation is to some extent the result of low profits, which is at the same time partially caused by the so-called "coffee crisis." A dramatic decline in prices has affected coffee farmers since 1997 (Petit 2007), depleting in some cases their ability to cover

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increasing production costs (Sachs et al. 2019). Coffee growers find themselves in a poverty trap whereby low profits lead to low investment and low yields in the following agricultural campaign, as well as low yields, lead to low income and profits. Even with quality price premiums, farmers do not see their income significantly increased. It has been shown that only one-third of the premiums are transmitted to producers in Ethiopia, and still, even if premiums were transmitted entirely, farmers would only garner an additional $22 per year (Minten et al. 2018). Quality incentives are simply inexistent in practice.

However, farm investments do not only depend on profits, but are also influenced by climate risk. As with any rational economic agent, producers factor in the uncertainty they experience regarding climate when making decisions on where to allocate their scarce resources. In other words, the threat of climate events such as droughts or heavy rainfall prevents coffee growers from making critical investments in their farms (use of improved seeds, application of fertilizers, etc.) due to the increasing probability of losing what they invested so much in (Barrett et al. 2007). Providing farmers with reliable, tailored climate information will therefore unlock investment opportunities to increase productivity and income.

Identifying climate information gaps

The two most important climate variables influencing coffee production in Ethiopia are temperature and rainfall. While the ideal parameters for both variables are around 18 to 21°C (Iscaro 2014) and 1,500 to 2,500 mm per year respectively (Tadesse et al. 2020), the outputs from climate models for this country do not seem favorable for coffee cultivation in the future (Kew & ECFF 2017). On one hand, temperature is expected to continue increasing in the country by 1.5 to 5.1°C until the end of the century. On the other, most researchers agree on the fact that rainfall will become more erratic in the years to come (Kew & ECFF 2017).

Although these scenarios provide a general outlook of the longer-term problem, they are not helpful in guiding the pathway for interventions in the short-run. As an example, rainfall projections are divergent, as climate models cannot accurately predict its behavior for the next decades (Kew & ECFF 2017, Iscaro 2014, Moat et al. 2017). Moreover, these models do not consider the diversity of landscapes where coffee is grown in the country or the multiple types of farming systems. One of the implications of having country level models is that they are not accurate for all the kebeles where coffee is cultivated, hence farmers cannot base their decisions on that sophisticated information. Timely and actionable climate information at the farm level is urgent, considering that Ethiopian coffee growers are already experiencing more recurrent extreme weather events such as droughts, heavy rains, frosts, among others. These occurrences are damaging all stages of coffee growing, especially flowering and preparation of mother trees, to the point that they could cause as much as 70% yield loss through flower abortion, fruit quality reduction, wilting, enhanced alternate bearing, aggravated berry disease, and other means (Tadesse et al. 2020).

Climate services at the farm level are therefore becoming more and more necessary. Decision support tools derived from climate information can assist farmers to make improved ex-ante decision-making, enabling early action and preparedness. As a testament to the power of climate information in informing adaptation decisions, a recent study in Jimma Zone suggests that climate information is the most important determinant for coffee growers to take actions for adaptation. These actions include the change of the planting date, change of crop type, change in crop variety, and soil and water conservation. It is even more important than access to extension services, a household's level of education, or the income from coffee (Eshetu et al. 2020).

By the same token, climate services need to respond to user requirements and be relevant and comprehensible to truly improve livelihoods. This is precisely the approach of the Adapting Agriculture to Climate Today, for Tomorrow (ACToday) project, led by the International Research Institute for Climate and Society (IRI) under Columbia University's Earth Institute. Recognizing climate information gaps at the farm level and the vulnerability experienced by countries like Ethiopia, the ACToday approach highlights the importance of the generation of climate knowledge, its translation into relevant information for farmers, the transfer of that information in different formats and through diverse channels, and the building of capacity to enable its effective use.

Certainly, the adoption of adaptation actions by coffee growers is crucial in the short-run, given that climate is expected to significantly affect this crop in the coming years. Infrastructure (irrigation) and farming practices (shading, mulching, terracing, among others) are the most cost-effective measures that have already taken place, and others more radical include switching to other crops (Moat et al. 2017).

Review of interventions and policies targeting Ethiopia's coffee value chain

The coffee value chain in Ethiopia is comprised of four main groups of stakeholders, which are illustrated in Figure 1 and briefly described below:

- Actors involved in coffee production: Smallholder farmers grow 95% of the coffee produced in the country, and the remaining coffee is grown in large plantations owned by the government (public plantations) and private companies.

- Actors involved in coffee processing: While large plantations do their own processing and sell the coffee directly to importers, smallholder farmers send their produce to other actors for the processing: (1) around 10% of smallholder volume goes to cooperatives, (2) 20% goes to private wet mills, and (3) 70% is collected by private hullers through collectors who visit the farms. It is worth noticing that there are two processing methods: 71% of total production is dry-processed while the 29% remaining is wet-processed (Duguma & Chewaka 2019).
- Actors involved in coffee trading: Cooperatives sell their produce directly to importers through cooperative unions, whereas private wet mills and hullers sell to exporters through a central auction (Ethiopia Commodity Exchange – ECX). Coffee that does not meet quality standards is sold locally; in fact, 50% of Ethiopian coffee is consumed within the country. Otherwise, around 60 active local exporters trade the coffee to importers mainly from the US and Europe.
- Supporting actors: Besides the actors involved directly with the product, there are others that provide assistance throughout the value chain. Among these, there are donors, development implementation agencies, research institutions, convening platforms, public bodies, and inputs/services providers.

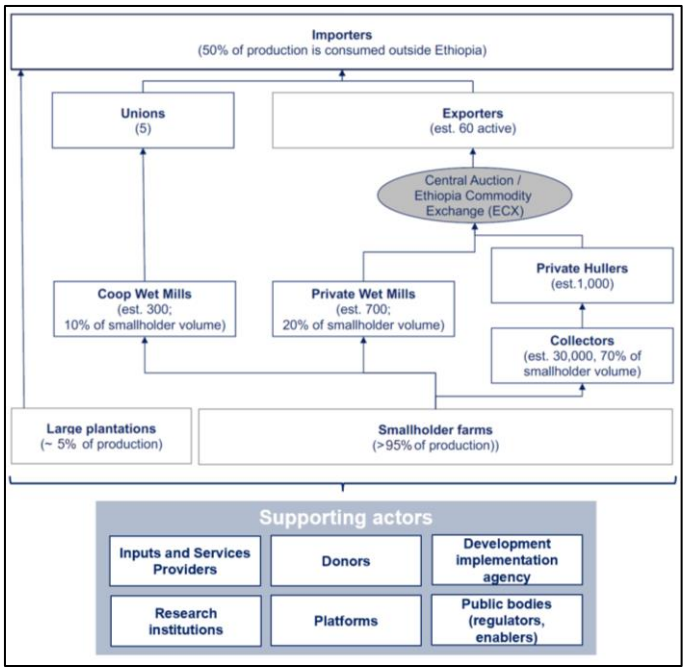

Figure 1. Structure of the Ethiopian coffee value chain (Adapted from Carl Cervone, 2020).

To better understand if and how these actors are addressing the climate issues that coffee production is facing, we analyzed 90 active interventions during the period from 2015-2020, and 82 value chain stakeholders, using an online search which only considered actors with a presence on the internet. As demonstrated in Figure 2, most stakeholders in the study belong to the fourth group of supporting actors (donors 27%, public bodies 14%, and development implementation agencies 13%), evidencing its major relevance in the Ethiopian coffee industry.

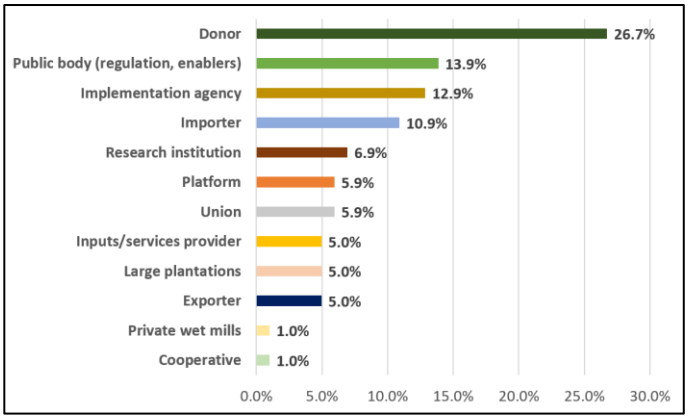

Figure 2. Mapped stakeholders by role performed in the coffee value chain.

Regarding the interventions of the study, the majority of them were multi-stakeholder interventions targeting smallholder farmers. Moreover, as illustrated in Figure 3, the leading organizations were mostly non-profits (28%), public institutions (27%), and international cooperation agencies (19%). This result suggests that community actors are not fully prepared to guide projects on their own or that they do not have the resources to do it. Unless projects include participatory approaches, it is probable that climate concerns remain unknown and unaddressed.

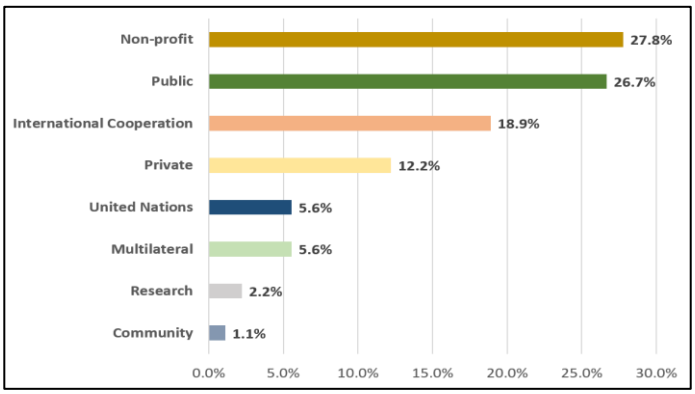

Figure 3. Interventions by type of leading organization.

It is important to note that the mapped public interventions include national policies such as the Growth and Transformation Plan (GTP), and the Climate Resilient Green Economy (CRGE), the plans of which considered activities addressing the coffee value chain. However, despite the economic importance of the coffee sector in supporting livelihoods and income towards the purchase of essentials like food, it has been seen that government actions tied to these policies for addressing food insecurity have been primarily focused on food crops and the promotion of agricultural diversification, to the detriment of the coffee value chain (Hirons et al. 2018). By postponing action towards climate adaptation, the sustainability of the

coffee sector and those who rely upon it for their livelihoods are being jeopardized.

In order to profile the interventions, we characterized them by the primary stage in the coffee value chain they targeted. As can be seen in Figure 4, the largest share of the interventions (70%) targeted the production stage of the value chain, focusing on improving productivity and smallholder farmers' agricultural practices. In second place, 22% of interventions aimed at promoting coffee trade and increasing marketing efforts, by developing a national coffee brand and facilitating trade with other countries. Further, 7% of interventions focused on improving coffee processing, working with cooperatives, and unions to upgrade their processes. Lastly, only 1% of interventions targeted coffee roasting, reflecting the fact that most coffee is traded as green beans.

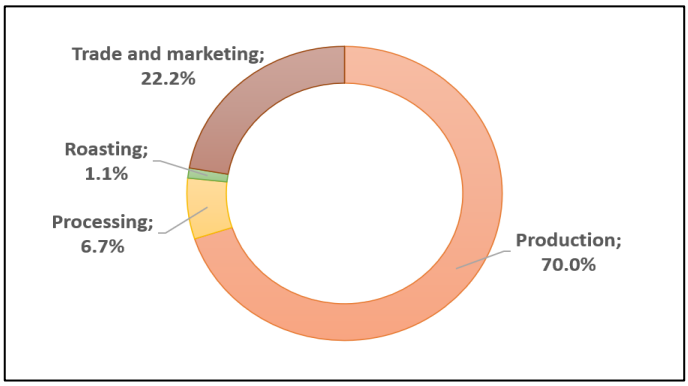

Figure 4. Distribution of interventions by primary targeted stage in the coffee value chain.

Even though climate variability and change are urgent matters for the coffee industry as explained before, we found that only about half of interventions (54%) addressed climate issues in one way or another. In some cases, the importance of this topic is acknowledged in the narrative of projects or programs but it is not translated into specific actions and indicators.

What is more, there appears to be little to no coordinated action on the adaptation front as projects, programs and policies addressing climate are more highly concentrated on the mitigation front. As shown in Figure 5, we found that, about 72% of interventions focused on mitigation (i.e. reduction of emissions) by encouraging sustainable agricultural practices, promoting conservation of forests or reforestation, developing local capacity to that end in the field, monitoring environmental standards, and reducing pollution sources. Moreover, only about 13% of interventions focused on research through climate data gathering or analysis and developing models to predict climate behavior in the years to come. Lastly, only the remaining approximately 15% of interventions focused on adaptation actions, including the sustainable management of water sources, the supply of infrastructure such as irrigation or storage units, and the provision of climate services. Some examples of climate services include alert systems, surveillance, climate information, agricultural and crop insurance, amongst others. It is worth mentioning that some interventions shared more than one approach to tackle the effects of climate change.

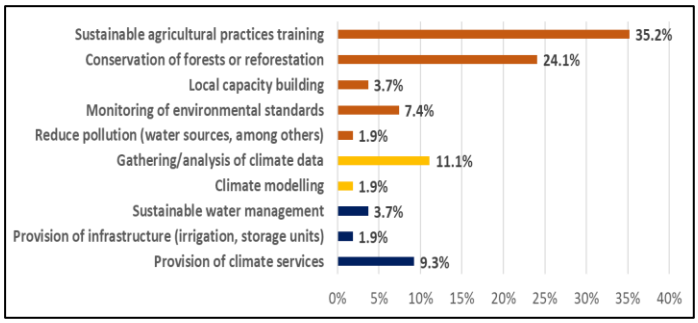

Figure 5. Intervention approaches to address climate.

While mitigation is of course key to minimize the unfavorable effects of climate change, adaptation is also important since repercussions will undoubtedly reach smallholder farmers, the most vulnerable group in the coffee value chain. Mitigation without adaptation means that producers will remain exposed to risks without the appropriate tools and resources to manage them. Climate services provide an opportunity to educate smallholder farmers about climate risks while simultaneously supporting their decision-making processes to manage these risks. However, despite the gravity of climate issues confronting farmers and potential for climate services to address them, only 9% of interventions addressing climate issues (6% of total interventions) in the coffee sector work on their provision.

My Coffee Farm: A decision-support tool for coffee farmers integrating farm-level climate information services and profitability estimates

The limited presence of climate services in Ethiopia's coffee sector suggests that actionable and tailored advice at the coffee farm-level for sustaining income in an uncertain climate is unavailable. Research and solutions to date have focused on managing climate information at the executive or technical levels, targeting only intermediate users, to the detriment of local scales where such information is most needed for decision-making. Bringing climate services to the farm-level is challenging but necessary to improve farmers' resiliency.

To this end, IRI, in partnership with the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), is working to close the climate information gap by empowering smallholder coffee farmers through the development of *My Coffee Farm*, a customized, dynamic advisory tool integrating farm-level climate information services and profitability estimates. What differentiates *My Coffee Farm* from other climate

tools is that it targets the end users, informing and educating farmers to easily understand the effects of climate change on his/her farm and his/her pocket. Our hypothesis is that customized information-technology solutions that integrate economic-sustainability assessment and seasonal-climate forecasts will impact smallholders' access to climate services, decision-making processes, and adoption of adaptation practices increasing resiliency.

Besides working to improve the availability of and access to climate data and forecasts to close the climate information gap in local communities, *My Coffee Farm* will also focus on the best ways to effectively disseminate this information. Climate data is complex. Thus, to be better understood by the farmers, it needs to be translated into actionable information. To keep the messaging relevant to farmers, the tool aims to help answer the question most farmers ask themselves: "To what extent will climate affect *my* coffee?", by using his/her expected profits under different scenarios. The final result farmers receive from climate variability and change is a diminished productivity that is translated into less money in their pockets. Expected income is what guides farmers to make production decisions (Eshetu et al. 2020). Accessing and understanding economic information like costs of production, income, and profits could help farmers identify gaps, motivating changes in their farming practices to improve productivity and profitability (Leshed et al. 2018). Linking climate to farm economics is a new and groundbreaking approach resulting in the improvement of climate resilience through timely adaptation actions. Furthermore, considering the continuous fall in prices, coffee sustainability also depends on the ability of farmers to make coffee production more profitable.

Another important feature of *My Coffee Farm* is its digital format. In a context with increased restrictions to reach farmers due to physical distance or logistic infrastructure limitations, a digital format makes it easier to reach more farmers and lays the foundation for scalability. The fast penetration, and the multiple available formats (online-offline software, usable in diverse devices, etc.) are additional advantages of going digital.

It is worth mentioning that this tool, beyond providing information to farmers, can be useful for policymakers as well. The extended use of *My Coffee Farm* will allow the tool's integrated forecast system to identify when the risks that farmers face trespass certain thresholds, putting in danger coffee sustainability in a particular region of the country. In a sector highly dependent on smallholder farmers' production, this information is valuable to design effective public policy.

Future directions and recommendations

The design of *My Coffee Farm* is at a preliminary phase. Currently, a process of collecting information from the field is being conducted, targeting coffee producers and professionals related to the value chain. Information being gathered includes local agricultural practices, production costs, recurring weather events and their effects on the coffee crop. The IRI and CCAFS are open to building partnerships, especially to undertake the next steps: (1) co-developing an advisory tool with local stakeholders, using a human-centered approach based on field data and including gender-sensitive strategies to ensure inclusion, (2) testing the digital prototype through pilots in Ethiopia, offering tailored, localized scenarios, and (3) assessing the preliminary results from the pilot and publishing the experience in open data platforms.

Evidently, efforts to promote adaptability to climate change and variability in the Ethiopian coffee chain must be strengthened, particularly by supplying climate services to smallholder farmers. Unless action is taken soon, the Ethiopian coffee sector and those who rely upon it for their well-being and livelihoods will remain vulnerable to the effects of climate variability and change.

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This Info Note summarizes the strategy of the project "Investigating the Coffee-Climate Nexus in Ethiopia" under the Sustainable Livestock Systems Program, aiming to systematize information on the current situation regarding climate information access and use from coffee farmers in Ethiopia, and finding better ways to approach farmers.

At the same time, the project was developed under the umbrella of the Adapting Agriculture to Climate Today, for Tomorrow (ACToday) project, led by the International Research Institute for Climate and Society (IRI) under Columbia University's Earth Institute, which aims to combat hunger by increasing climate knowledge in six countries that are particularly dependent on agriculture and vulnerable to the effects of climate variability and change: Bangladesh, Colombia, Ethiopia, Guatemala, Senegal, and Vietnam.

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