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State of the Smallholder Coffee Farmer: An Initiative Towards a More Equitable and Democratic Information Landscape

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Photos on the cover:

Shade-coffee agroforestry system in Copán, Honduras (credit: V. Ernesto Méndez) and Nicaraguan farmer with her coffee plants (credit: Heifer International/Phillip Davis).

1. Executive summary

Introduction

Smallholder coffee farmers play a vital role in the coffee industry, producing about 60% of the global supply, conserving biodiversity and culture, as well as sequestering carbon. These farmers currently face a myriad of challenges, ranging from price variability to climate change. Given the growing importance of smallholder coffee farmers for the industry, a variety of sustainability efforts have been initiated to support them, including those around data collection and management. One key lesson emerging from these efforts is the need to improve multi- stakeholder initiatives (MSIs) and find ways to fully include smallholder farmers in them. The general objective of this initiative was to pilot an alternative approach to search for, analyze and share selected socio-economic and environmental data, of importance to smallholder coffee farmers in Guatemala, Honduras and Nicaragua.

Guatemalan farmer with his coffee plants. Credit: Heifer International/Phillip Davis.

Our Approach

Our approach consisted of an extensive data search of accessible information and interviews with coffee value chain actors working with smallholder coffee farmers. The data were then processed and curated into the State of the Smallholder Coffee Farmer platform and, along with additional data from the literature, used to generate the report. The platform and the report will also be translated into Spanish, as soon as they are completed.

Findings

General description of the indicators

A total of 214 indicators with 630 indicator values or data points were found and uploaded to the platform. Indicators were organized into five main categories: (1) Household demographics, (2) Farm characteristic, (3) Economic, (4) Social, and (5) Environmental.

Selected socioeconomic characteristics of coffee smallholders

- *Coffee production and its economic contributions* remain important in Guatemala, Honduras and Nicaragua, with each of these producing 4 million, 7.1 million and 2.9 million 60-kg bags, respectively, for the 2018/2019 harvest. Contributions from coffee exports to Gross Domestic Product (GDP) in the three countries also increased over the last 3-5 years.

- *Smallholder coffee producers constitute the majority of coffee farmers* in the three countries, although they produce less than half of total coffee, with the exception of Honduras.

- *Poverty continues to severely affect smallholder coffee farmers*, a situation in stark contrast with the prosperity of other coffee value chain actors, especially those located in the global north (i.e. roasters, importers, retailers, etc.).

- *Income diversification* is an important indicator that has been associated with building stronger livelihood strategies for coffee households. The results for this indicator were dispersed, with no clear trends. In Nicaragua, one case study reported 1.13 sources of income and another 5 income sources (2013). All other figures for specific cases were somewhere in between for the three countries.

- *Percent of income from coffee* in relation to total income, is also tied to income diversification. In Guatemala, half of the studies included in this pilot showed an average percent coffee income of 75%; others showed average values between 40 and 65%, and low range values between 2 and 27%. For Nicaragua, the average value was mid-range (44.8%).

- *Food insecurity* in smallholder coffee households has been increasingly documented as recurring cycles of annual, seasonal food scarcity, commonly called the 'lean months'. The average length of seasonal food insecurity in the studies from Guatemala was between 0.2 and 2.8 months, while in Honduras it ranged from 1.5 to 2.1 and in Nicaragua from 2.2 to 3.2 months. Nicaragua had one robust longitudinal data set.

Environmental characteristics of coffee smallholders

- *Diversified shade tree management* is associated with a variety of ecosystem services, and a proxy for sound environmental stewardship. In Honduras, it is reported that between 95 and 98% of coffee is under some type of shade; in Guatemala the figure found is 98% under shade, and in Nicaragua it is an estimated 96% shaded coffee.

- Third party voluntary sustainability standards (VSS), such as s Fairtrade (FT), organic, etc. seek to enhance the sustainability of coffee production, and include environmental standards that can be used as a proxy for environmental stewardship. An estimate of the percentage of FT certified smallholder farmers was 11% for Guatemala, 9% for Honduras, and 46% for Nicaragua.

- *Agrobiodiversity in coffee farms and landscapes* provides multiple benefits to households, ranging from dietary diversity to additional income. One of the most comprehensive studies for Central American smallholder farmers found values between 5 and 10 tree species per ha, in 2 sites of Guatemala and 1 in Honduras.

- *As climate change rages on, carbon sequestration in shade coffee* has taken on increasing importance. In Nicaragua, a comparison between different shade types found C stocks in aboveground biomass varied from 8.8 Megagrams of carbon per hectare (Mg C ha-1) in full-sun to 38.6 Mg ha-1 in diverse shade-coffee systems. A study between 2007 and 2010 in Guatemala, showed total C stored in shaded plantations had a mean of 127.6 Mg C ha-1. These findings were in line with similar studies in other regions.

- *Presence and number of agroecological/soil conservation practices on-farm* is also an important indicator of environmental stewardship. In Nicaragua and Honduras, practices in two farm types- smaller/less diverse and larger/more diverse- showed an average of 5.5 (Honduras-HN) and 5.6 (Nicaragua-N) agroecological practices, in smaller farms, and an average of 11.9 (HN) and 10.7 (N) in larger farms. A study focusing on 10 'Ecosystem-based Adaptation (EbA)' practices reported that Guatemalan sites had an average of 2.83 and 3.7 EbA practices, respectively, with an average of 5.38 practices in Honduras.

Interviews with actors working with smallholder coffee farmers

Nearly all 23 organizations that were interviewed for this pilot collect some data on smallholder coffee farmers, although the reasons for these efforts vary. Data are collected for project impact assessment, tracking sustainability commitments, monitoring standards, informing decision-making, and for scientific understanding. Discussions focused on challenges and opportunities related to indicator standardization, data harmonization, data quality and robustness, and data sharing as related to confidentiality, legal issues, and policies of different actors. Everyone recognized the importance of data for better decision-making, and most agreed that initiatives like the State of the Smallholder Coffee Farmer platform could be useful. However, they were also cautious and noted there have been similar initiatives in the past, which have proven unsuccessful.

Discussion

When comparing the information found and curated in the platform with data from other coffee regions, similar results were found for several of the factors we analyzed. These included income diversification, food security, and agrobiodiversity. Moreover, the following lessons learned were extracted from this process, as related to the data collection, curation, and analysis:

- *Publicly available data and information are limited.* The systematic search carried out as part of this pilot yielded fewer results than was expected. While there are considerable efforts to collect and store data about smallholder coffee farmers (for varying purposes), a lot of the data and information are not made publicly available.

- *There are barriers to accessing data.* Even when the data or information are made public, it can take significant effort to find them on the websites.

- *"Same, same, but different".* There is a lot of variability in the indicators and metrics that are being used. Although many indicators appear to be similar, they are not exactly the same, which makes it difficult to compare or aggregate data.

- *Lack of longitudinal data.* Another key issue identified during this pilot is the lack of longitudinal data, i.e., data collected from the same respondents at different points in time. To analyze trends or evaluate change over time – for instance, after a major event, such as a price crisis – more longitudinal data is required.

There is an opportunity to connect the platform to the field of agroecology, which has a long history of work with coffee smallholders and can provide methods and tools towards a more ecologically sound and socially just coffee value chain.

Conclusions

Data on diversification, food security, and agrobiodiversity, among others, show persistent trends in the three countries, that is, of households struggling to attain enough income, meet family food needs, and conserve important plant biodiversity. While there is abundant data and information that can allow us to better understand the 'state of the coffee smallholder farmer', there are also many gaps in data availability, comparability, and quality. There are also serious challenges to accessing and using information. If the community of actors working with smallholder farmers wants to benefit from the wealth of data they and others collect and move towards a more equitable and democratic information landscape, more coordinated efforts are needed to improve the processes of collecting, systematizing, sharing and using data. Collaborations among various actors, with real participation from all (with emphasis on the participation of smallholder farmers and cooperatives), could strengthen these processes and reduce the burden of data collection and management. The State of the Smallholder Coffee Farmer Platform is one effort towards that goal.

2. Introduction

2.1 Context

Smallholder coffee farmers play a vital role in the coffee industry, producing an estimated 60% of the global supply (Carto, 2019). They also generate social and environmental benefits that have a ripple effect beyond the coffee sector (Perfecto and Vandermeer, 2015). Smallholder farmers typically produce coffee in diverse, shaded agroforestry systems that contribute to biodiversity, food security, and cultural conservation, as well as climate change mitigation through carbon sequestration in plants and soils (Méndez et al., 2012; Toledo and Moguel, 2012; Perfecto and Vandermeer, 2015; Guzmán-Luna et al., 2019). These farmer households also contribute to the livelihoods and economies of their regions and countries through job creation and coffee exports (Jha et al., 2011; Jezeer et al., 2017).

Coffee as a commodity is highly susceptible to price fluctuations. As shown in Figure 1, there has been a downward trend in prices since 2014, with some rare spikes. At the same time, the costs of coffee production have continued to rise in most producing countries (SCA, 2019; ICO, n.d.) While price volatility affects everyone in the coffee industry, smallholders are often the most vulnerable to low prices. In late 2018 and 2019, the commodity futures market (the 'C market') price hovered around $1/lb, which means a lot of farmers were operating at a loss (SCA, 2019). As coffee smallholder families have typically made significant investments in their plantations, and may lack other viable livelihood alternatives, many are likely to continue growing coffee even when they end up losing money (Pendergrast, 2013; Eakin et al., 2011).

In addition to price instability, smallholder farmers are affected by other socioeconomic and environmental challenges, such as food insecurity, environmental degradation, political instability, and more recently, the global COVID-19 pandemic (Bacon et al, 2008; Jaffee, 2014; ICO, 2020). Additionally, it is worth mentioning climate change as a key factor severely affecting smallholder farmer's livelihood vulnerability (Läderach et al. 2017). Recent studies show that Central America is one of the regions that will likely be most severely affected by climate change (Hannah et al., 2017). Regional projections suggest that for coffee farmers this may mean significant reductions in land suitability for coffee (Läderach et al. 2017). Direct impacts of climate change on coffee farms include an increase in the prevalence of coffee pests and diseases (such as coffee leaf rust), as well as unpredictable flowering and drought (Läderach et al. 2017). All of these compounding challenges can lead to

Coffee farmer resting in a coffee plot in Guatemala. Credit: Heifer International/ Phillip Davis.

1. There are different definitions about smallholders. Typically smallholders are reliant on family labor and have less than 15 hectares of coffee, although the average landholdings can vary greatly (Lowder et al., 2016). The percentage presented here (60 %) includes farmers with less than 5 hectares in coffee (CARTO, 2019).
2. For instance, the SCA estimates that a price threshold for farm profitability is around $1.14/lb, although there are differences among countries and regions (SCA, 2019).

decreased yields, crop losses, reduced income, and the need to seek new livelihood alternatives (Caswell et al., 2014; 2016). As seen during the most recent price crises, many coffee farmers were forced to migrate as coffee became unprofitable (Wootson & Sieff, 2021). Many others may shift to other land uses and crops that, in some cases, can be less environmentally friendly than shade-coffee systems (Tucker et al, 2010; Harvey et al., 2021).

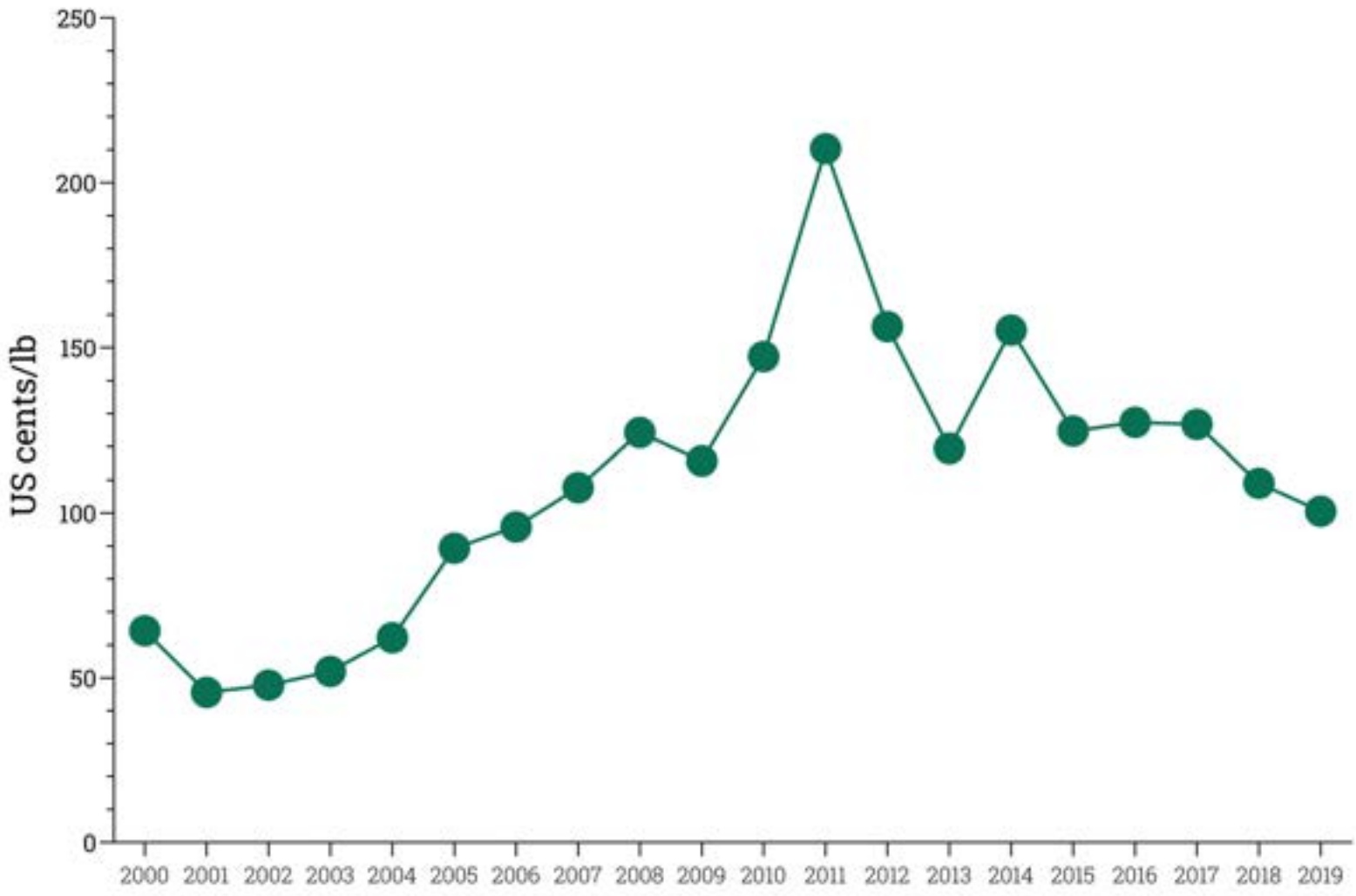


Figure 1. In the past 20 years, coffee prices have luctuated heavily. This graph shows the annual average price in US cents/lb using the ICO composite indicator (including prices of four main types of coffee qualities: Colombian mild Arabicas, other mild Arabicas, Brazilian and other natural Arabicas, and Robustas). The averages for Arabicas alone are slightly higher. Annual averages were calculated using the ICO Composite & Group Indicator Prices data. (Source: ICO, 2021).

BOX 1: Fluctuating Coffee Prices

The 'boom and bust' cycles in coffee and the accompanying fluctuations in prices have been a persistent characteristic of the global coffee trade throughout its history (SCA, 2019). The volatility of green coffee prices results from many interrelated factors that can be summarized as "market forces, complicated by nature and human greed" (Pendergrast, 2013). One important element is the structure of the global coffee trade, built largely around the 'C market' and New York Coffee Exchange that are instrumental in setting the C market price (SCA, 2019). Other contributing factors include market speculation and the inelasticity of supply. Coffee is a perennial crop which means there is a long lag between coffee planting and harvesting (Amrouk, 2018; SCA, 2019). In years of high prices, farmers typically plant more coffee, which can lead to overproduction; when a bust cycle hits, farmers are often stuck with a lot of coffee and low (or no) profits (Pendergrast, 2013). Finally, weather shocks often cause shifts in the global coffee supply, having consequences on the coffee prices (SCA, 2019).

The most recent price crises prompted coffee industry actors associated with the smallholder sector to reconsider their own role in issues of price and other challenges. For example, the Specialty Coffee Association (SCA) recently launched the Coffee Price Crisis Response Initiative (PCR, https://sca.coffee/pricecrisis), as part of its research program, signaling its perceived significance from this lead industry organization. The PCR Summary of Work includes several recommendations to foment change in the coffee industry and avoid future price crises, such as pursuing new models of governance in coffee that shift power to the producers and more equitable information sharing (SCA, 2019).

2.2 Complementary Initiatives

Given the importance of smallholder coffee farmers for the industry, as well as to their nations' economies, there has been a long history of initiatives to try to support them. These have taken different forms, ranging from traditional rural development projects to ones more focused on coffee. One key lesson emerging from these programs is the need to expand the scope of stakeholders involved in these efforts. In other words, smallholder issues are coffee value chain issues, and long-standing solutions to these challenges will require participation from all the actors in the value chain. Currently, smallholder farmers and their cooperative have little to no voice or power in the decisions that drive the coffee value chain, which in turn affect them directly. Increasing the voice and participation of actors at origin, and specifically smallholder farmers and their organizations, is necessary to resolve some of the most serious issues facing the coffee sector at present and in the future.

In the last 5-7 years, there has been an influx of multistakeholder initiatives (MSIs), intended to mobilize coffee actors across the value chain, and to collaborate in identifying—and theoretically achieving— sustainability objectives. Many of these have been focused, directly or indirectly, on issues affecting smallholder farmers and cooperatives. Whether through facilitation or funding, the private sector tends to be at the heart of many of these initiatives, which has resulted in research and objectives leaning in the direction of meeting corporate needs over those of producers. As recognized by the 2020 Coffee Barometer, the challenges these MSIs face in achieving direct, substantive impact are vast; these include: lack of aligning interests and unbalanced power imbalances amongst members, insufficient resources and investment, and lack of consensus on primary goals and targets. Additionally, it has been challenging to develop economic benchmarks at origin, which can address the situation of smallholders more realistically and at a deeper level. All of these issues are underpinned by a fundamental inability to reconcile the industry's objective to sustain growth, with the primary needs of farmers to sustain their livelihoods, farm ecosystems and communities.

To guide transformations in the coffee supply chain in support of coffee smallholders, it is essential to have up-to-date, high quality data. There have been numerous case studies and cooperative-level research efforts to document socioeconomic and environmental characteristics of coffee smallholders' farms and livelihoods (e.g., Anderzén et al., 2020; Bacon et al., 2014; Caswell et al., 2016), as well as some extensive review papers synthesizing research on smallholder coffee production (Harvey et al., 2021; Jha et al., 2011). Moreover, several recent landmark studies have discussed aspects of smallholder farmer sustainability, including the 2020 Coffee Barometer, the 2020 Specialty Coffee Transaction Guide, the Task Force for Coffee Living Income Report, the Ensuring Economic Viability and Sustainability of Coffee Production report, the 2019 Coffee Development Report, and the Price Crisis Response Summary of Work.

However, even with substantial research efforts, there are still many gaps in the data. We concur with Harvey et al. (2021) who note that more data is needed about changes in coffee production - driven by various factors such as climate change and price fluctuations - as well as the ecological and socio-economic impacts of these changes for coffee smallholders. This type of information would allow for a broader picture of smallholder farmers' livelihoods, contributions, and challenges at the national or regional level, as well as support decision-making. In addition, an intentional effort to generate longitudinal data, where information is collected in the same places and with the same methods over several years, would allow for the examination of trends and changes over time. And finally, there are serious obstacles in making data available to all those who would benefit from it, mainly coffee cooperatives, and smallholder farmers.

Objectives

In response to the increasingly precarious situation facing smallholder coffee families, as well as information gaps and the limitations of some of the previous initiatives, this project was launched to explore new ways to find, synthesize and share socioeconomic and environmental data about coffee smallholders in Central America. Bringing data together in

this way provided the possibility to undertake analyses that could inform initiatives to support smallholder coffee farmers, and advocate for relevant shifts towards collaborative reform within the coffee industry. The specific objectives were as follows:

1. Assess existing data on selected economic, social and environmental factors, at a variety of scales (i.e. regional or national), for smallholder coffee farmers in Central America

2. Analyze the degree(s) of availability for the existing data, as related to actors in the coffee sector (i.e. is it fully or partially accessible?)

3. Examine the needs and perspectives of coffee actors as related to smallholder socioeconomic and environmental data

4. Assess advantages and limitations to the accessibility and synthesis of data on smallholder coffee farmers through a public, online platform. The report and the platform complement other initiatives that – in various forms - seek to gather, synthesize, and analyze data about coffee smallholders.

3. Approach

This pilot used a transdisciplinary approach to find, analyze, and synthesize data and information about the conditions and contributions of coffee smallholders in Guatemala, Honduras, and Nicaragua. These three countries were chosen because they are three of the highest coffee exporters to the US, and UVM, Heifer International and LWR have had past and current experiences working with smallholders from these countries. This research approach could be applied to other smallholder farms, from a variety of geographical contexts, and become a tool to provide information about the livelihoods of smallholder coffee farmers. The data collection process consisted of an extensive data search, a desk review of relevant gray and scientific literature and a series of interviews with coffee value chain actors that work with smallholder coffee farmers. The methods are described in more detail in the following sections.

3.1 Data search

Over several months a large variety of sources - both public and restricted - were searched and revised to obtain data and information that were pertinent to selected economic, social and environmental aspects of smallholder coffee farmers in Guatemala, Honduras and Nicaragua. The data sources were identified as follows:

- Online open-source data libraries maintained by research, international development, industry and related institutions, such as Dataverse, USAID, the International Coffee Organization (ICO), the World Bank, and others.

- Data and information contained on websites and in reports conducted by (international) development organizations and national institutions that work directly with coffee farmers, as well as coffee cooperatives. We also contacted our networks and colleagues in several organizations to access anything not published online.

- Scientific articles.

3.2 Interviews with organizations and companies working with smallholders

Following the data search, the team reached out to several actors working directly or indirectly with smallholder coffee farmers in Central America. The aim was to hear early-stage feedback about the premise of an open-sourced data platform focusing on socioeconomic and environmental indicators of coffee smallholders' livelihoods, and to invite them to donate data or information. Thirty-three invitations were sent out via email, which yielded a response from 23 organizations or individuals. These actors included nonprofits, coffee companies, researchers, and certification bodies of varying sizes, located in the U.S.A., Nicaragua, Mexico, and Germany (see Annex I). The team had rich conversations with each of these organizations and individuals. These dialogues provided important insights about the possibilities and obstacles around data gathering, availability and sharing, and the specific data/information needs that different actors working with smallholder coffee farmers have. The findings from these interviews are summarized in section 5. These actors were also invited to donate publicly available data and information about smallholder coffee farmers that they work with in Guatemala, Nicaragua, and Honduras. As a result, the team received additional data and information from some of these organizations as well as many great resources, suggestions, and links that were helpful with setting up the platform.

3.3 Data processing, curation and the online platform

The data search and interviews were followed by data curation, in the form of selecting relevant indicators from various sources and organizing them. Pre-calculated indicators contained in reports, websites, spreadsheets, and academic papers were chosen, and raw data were used to calculate indicator values. The indicators were then integrated into an open access online platform (https://coffeesmallholder.org/), which was developed to facilitate access to the curated indicators. See Annex II for more details about the indicators and the selection process.

Many of the sources included in the platform were used to inform the data analysis in this report (see section 4). It is recommended that interested readers visit the platform to find additional information.

In the platform, it is possible to search indicators, browse them by categories, or filter by characteristics such as year, country, source type, purpose, gender, and scope. Indicators can be viewed or downloaded as an excel file or pdf report. It is vital to keep in mind that indicators may not be directly comparable. It is recommended that the users of the platform carefully review all information provided with the indicator value and, whenever possible, refer to the original source(s). It is also important to point out that the information on the platform only describes certain aspects of the lives and livelihoods of a very diverse group of coffee smallholders in three countries , and making generalizations or seeking to prove causality based on this information is not advised. However, we hope that people looking for indicators about smallholder coffee producers will benefit from having easy access to this curated collection of indicators.

Increasing the robustness and applicability of the platform will require considerable additional effort, and taking it to its full potential would entail developing collaborative agreements and common protocols that would lead to continuous data acquisition, from the same locations, on a regular basis. This would be one way to make longitudinal analyses possible, something that could provide very important information about real trends affecting smallholder coffee farmers over time.

Nicaraguan farmer holding a large sack of corn she harvested. Credit: Heifer International/Phillip Davis.

3.4 Data Sharing

This pilot project sought for all of the information gathered in the platform and discussed in the report to be useful to a wide audience of actors in the coffee value chain, including coffee cooperatives and smallholder farmers. To this end, the platform and the report will be translated into Spanish. However, as researchers and professionals actively engaged with coffee farmers, the team knows it will be difficult for this information to be used directly by cooperatives and farmers. Breaking the barrier between data generation and direct use by farmers and communities, on the ground, is one of the most serious challenges for engaged scholars. Access to the data and the instruments is not sufficient, there needs to be a process of co-learning among researchers, farmers, and other actors to find the right way for information to be organized, presented, and made accessible, so that it is actively used. This is beyond the scope of this initiative, but the pilot team hopes that this can be a first step to not only improve our efforts in data collection, curation and access, but also in making it usable by cooperatives and farmers.

3.5 Limitations of This Initiative

There are several limitations to this pilot. First, due to COVID-19, the team was not able to collect any primary data in any of the countries, so the study only included data from existing, secondary sources. Second, most sources included in the pilot were in English. Future iterations with a broader reach should explore more sources in Spanish, French and Portuguese, in collaboration with national coffee institutes, international researchers and smallholder cooperatives. Third, the main source for this pilot was publicly available data. This was mainly due to time limitations, as sharing 'raw data' or non-public reports/publications often requires a longer process. Fourth, for some sources that related to producers of all sizes it wasn't possible to disaggregate smallholders, which means some meaningful sources had to be left out from the platform. Finally, there are many other ways the data and information could have been presented in this report. In a possible subsequent phase of this initiative, the initial categories can be adjusted to make them as meaningful and relevant as possible to all users.

4. Findings

4.1 Indicator Overview

Following the data curation, a total of 214 indicators, with 630 indicator values or data points were included in the platform. The number of individual indicators shows how diverse and scattered the available information is - only a few indicators (e.g., number of household members, land under coffee, and coffee yield) yielded more than ten data points. In many

sources, the sample size was relatively small (<100 farmers), with larger groups of farmers included in some academic studies where household surveys were conducted. The platform includes data from all three countries, although in the sources we identified, the Guatemalan coffee lands were slightly overrepresented. The type of sources that contained the most information were academic publications, impact studies, and baseline studies. Most data we found was not disaggregated by gender.

The indicators were organized into five main categories in the platform:

- **Household demographics**
- **Farm characteristics**
- **Economic**
- **Social**
- **Environmental**

In the following sections, the data for selected, key socioeconomic and environmental indicators are presented in more detail. However, it is highly recommended that the readers visit the platform to obtain more information about the indicators included in each category. This is important, as due to the characteristics of the data – e.g., diversity of indicators, the relatively small sample sizes, and lack of gender-specific data – generalizations of smallholders in any of the three countries could be misleading, and indicators alone are not enough to tell a story.

Farmers' market run by women in Nicaragua. Credit: Food 4 Farmers.

4. 2 Socioeconomic Characteristics

Coffee Production and Economic Contributions (national level)

Coffee is among the major export products in Honduras, Guatemala, and Nicaragua, and contributes significantly to the national economies of these countries. In Honduras, coffee is grown in 15 of its 18 departments and occupies approximately 333,600 hectares of land (USDA Foreign Agricultural Service, 2020). In 2018/19, Honduran farmers produced 7.1 million bags (60 kg) of coffee (ICO, n.d.), making it the leading coffee producer in Central America, and the fifth largest exporter globally. Although Honduran production was affected severely by the coffee rust epidemic in 2012/13, farmers made a relatively quick recovery by planting rust-resistant varieties, and production was growing steadily between 2015 and 2019 (USDA Foreign Agricultural Service, 2014; USDA Foreign Agricultural Service, 2020; ICO, n.d.). The importance of coffee for the national economy has been increasing over the past two decades: between 2003-2007, coffee accounted for 2.4 % of the annual GDP, on average. In 2015, the coffee sector accounted for 3.5 % of the GDP and around 30 % of the agricultural GDP of the country (World Bank, 2015); in 2020, coffee contributed 5 % to the GDP (USDA Foreign Agricultural Service, 2020; see Figure 2). Following the manufacturing sector, coffee is now the second highest value export (Bunn et al., 2018).

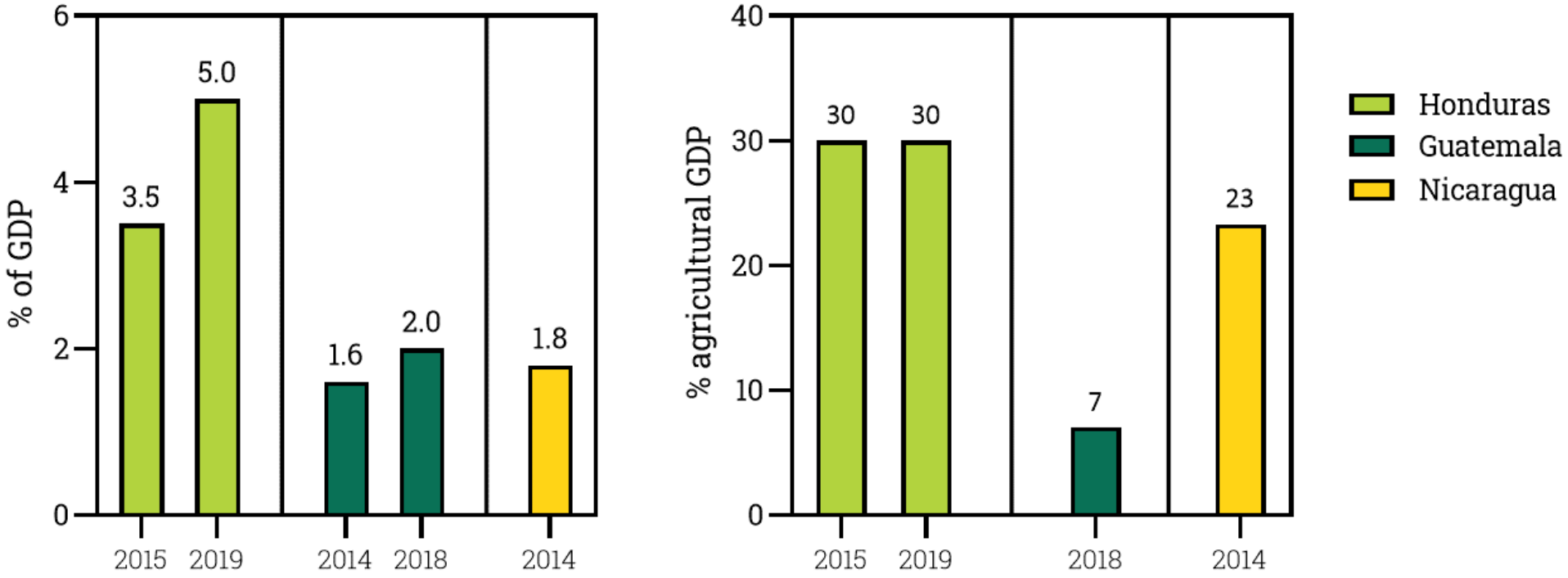


Figure 2. Contribution of coffee to national GDP (left) and agricultural GDP (right) for Honduras, Guatemala, and Nicaragua. (Sources: World Bank, 2015, Anacafé, 2019; USDA Foreign Agricultural Service, 2019a, 2019b, ICO, 2016).

3. Our original selection included more data points, but we decided to leave out some of them. The main reason was the lack of metadata or limited information about the data collection methods.
4. In section 4, we narrow our description in most cases to data from 2013 to 2019. However, in the platform we have included older information as well.

In Guatemala, coffee is produced in 20 out of 22 of its departments, and it covers an area of approximately 305,000 hectares (Anacafé, 2019). The coffee rust outbreak (2012-14) caused major damage to coffee production and reduced it by 20-25 % from a record high harvest cycle of 2011/12 (USDA Foreign Agricultural Service, 2015). Production started increasing again in 2014/15, and by 2018/2019 it reached 4 million bags in 2018/19 (ICO, n.d.). Coffee is the second most important agricultural product in Guatemala - in 2018, it represented 24.6 % of all agroindustry exports and accounted for approximately 7 % of the agricultural GDP (Anacafé, 2019; USDA Foreign Agricultural Service, 2019a). The same year, the coffee sector's contribution to the GDP in Guatemala was approximately 2 % (USDA Foreign Agricultural Service, 2019a), while in 2014, the percentage was at around 1.6 % (Hernandez et al., 2014). According to a World Bank report, the contribution of coffee to the GDP is lower than in some other major coffee producing countries (Hernandez et al., 2014).

In Nicaragua, coffee is mainly produced in Jinotega, Matagalpa, and Las Segovias in the North Central Region of the country. The land area under coffee is smaller than in Guatemala and Honduras, at approximately 140,000 hectares in total (USDA Foreign Agricultural Service, 2019c). Coffee production plummeted following the coffee leaf rust outbreak but has been slowly recovering since. In 2018/19, Nicaraguan farmers produced 2.9 million bags of coffee (60 kg) (ICO, n.d.). According to one source, that cites the Central Bank of Nicaragua, coffee constituted 1.8 % of the GDP and 23.3 % of the agricultural GDP in 2014 (ICO, 2016). More recent data on coffee and GDP were difficult to find; however, coffee was the 4th most exported product in Nicaragua in 2019, suggesting its economic importance remains high for the country (OEC, n.d.).

Smallholder producers and coffee sector employment

As in many other coffee producing countries, smallholder farmers are at the heart of the coffee sector in Honduras, Guatemala, and Nicaragua. They constitute the majority of coffee farmers and produce an important share of the annual coffee in the three countries. As shown in Figure 3, in Honduras, approximately 96 % of the country's 105,700 farmers are smallholders, having less than 10 hectares of coffee. In 2019, 79 % of the smallholders grew coffee in less than 3.5 hectares of land and produced 36 % of the Honduran coffee. When including all farmers with less than 10 hectares of coffee, their share of the national production was 68 % (ILO, 2020). In Nicaragua, there are around 44,000 coffee producers, and the share of smallholders is approximately 97 % (USDA Foreign Agricultural service, 2017a). Although this percentage includes all farmers with 14 hectares or less in coffee, the average farm size is between 1.5 to 2.5 hectares (USDA Foreign Agricultural service, 2017a). According to a USAID report, larger farmers dominate national production, with smallholders producing less than half (~40 %) of all coffee (USAID, 2017).

In Guatemala, smallholders constitute 97 % of the country's 125,000 coffee farmers (Anacafé, 2019). The average farm size is typically 2 hectares or less, with many producer families growing coffee on less than a hectare (USDA Foreign Agricultural service, 2017b). The contributions of smallholders to the total national production have grown in recent years: in

2008/09, smallholder farmers produced roughly 20 % of all Guatemalan coffee, while the percentage in 2017/18 was approximately 47 % (Bunn et al., 2019; USDA Foreign Agricultural service, 2018). Especially since the coffee rust outbreak, many larger landowners have abandoned coffee and shifted to more profitable crops (USDA Foreign Agricultural service, 2017b). While the number of smallholders has also declined in recent years, small producers are generally less likely to abandon coffee - prior studies have shown that smallholders often lack the resources (land, credit, workforce, etc.) to make major changes on their farms and/or may find coffee less risky than diversification alternatives (Tucker et al, 2010; Eakin et al., 2011).

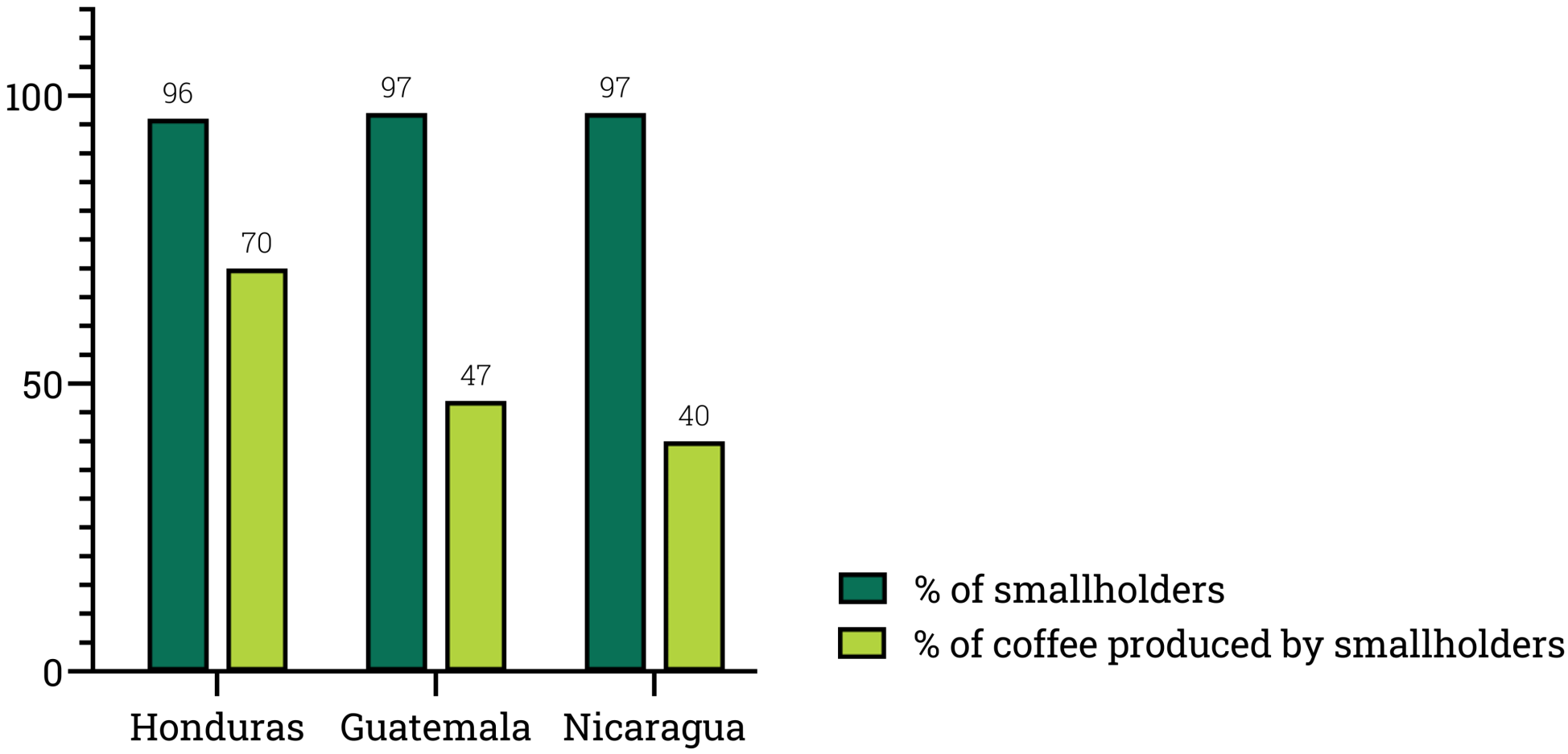


Figure 3. Proportion of smallholders of all producers and percentage of all coffee produced by smallholders, (Sources: USDA Foreign Agricultural service, 2017a. 2017b, USAID, 2017, Anacafé, 2019, Bunn et al., 2019; USDA Foreign Agricultural service, 2018, ILO, 2020).

In addition to smallholder producers, the coffee sector generates employment for hundreds of thousands of people across Central America (see Figure 4). In Honduras, coffee is a major source of employment: it is estimated that the sector provides employment to 1 million people, which represents one in five rural workers, and one in 10 overall workers (Bunn et al., 2018). However, declining coffee prices have caused a decrease in all coffee activities and on-farm employment. According to a study conducted by the International Coffee Organization (2019), on-farm employment fell by 20% in Honduras between 2016 and 2018. In Guatemala, coffee generates jobs for 500,000 people, employing approximately 9 % of the workforce (World Bank, 2014). The number of people working in coffee has been declining over the past two decades, and especially in recent years with low coffee prices and increasing costs, many farmers have had to cut down on labor (USDA Foreign Agricultural service, 2018; Bunn et al., 2018). In Nicaragua coffee employs approximately 332,000 people, which is equivalent to over

half (54 %) of the rural workforce (USDA Foreign Agricultural service, 2017a; Castellano, 2021). According to another source, the proportion is a little lower, roughly one third of the rural workforce (Escobedo et al., 2017).

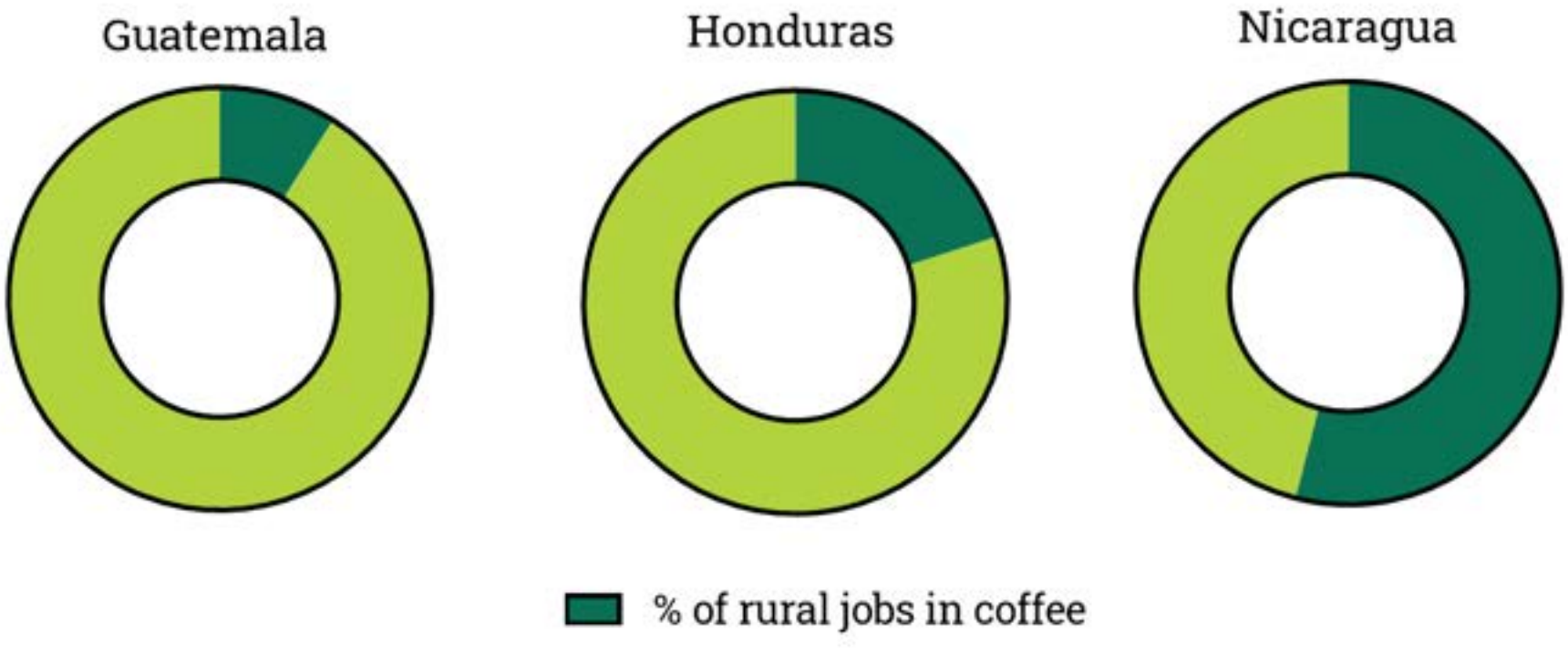


Figure 4. Proportion of coffee sector jobs of all jobs in rural areas - Guatemala ~9 %, Honduras ~20 %, and Nicaragua ~54 %. (Sources: Hernandez et al., 2014; Bunn et al., 2018; USDA Foreign Agricultural service, 2017a; USDA Foreign Agricultural service, 2018; Castellano, 2021). According to Escobedo et al., 2017, the proportion is a little lower in Nicaragua, roughly one third of the rural workforce (Escobedo et al., 2017).

Smallholder Coffee Households Living Below the Poverty Line

For decades, academic papers and books, reports and newspaper articles have stated that smallholder coffee farmers at origin face pervasive poverty (Bacon et al., 2008; Jaffee, 2014). The data-gathering efforts for this pilot yielded relatively few sources documenting poverty that smallholder coffee farmers face in Guatemala, Nicaragua, and Honduras (between 2013-19). One exception was an impact study from Guatemala, conducted in four locations in 2013, with a total of 407 households, which documented the percentage of coffee farmer households living below $2.50 per day (Root Capital, 2014). The study shows that the proportion of farmers living below this poverty line varied among the four locations, ranging from 17.5 % to 52.8 %. Generally, the farmers belonging to farmer cooperatives were doing a little better economically than those who did not (Root Capital, 2014).

These pervasive conditions may get a little better or a little worse, depending on coffee and staple crop production, international coffee prices and other factors that vary over time. For example, a recent survey by the ICO, for which we could not obtain the raw data, suggests the proportion of farmers living below the poverty line of US$1.90 per day, increased between 7% and 50% in 8 producing countries of Africa and Latin America (Nicaragua, Cameroon, Tanzania,

Sierra Leone, Costa Rica, Peru, Honduras, and Uganda) (ICO, 2019). The aim of the survey was to document impacts of declining coffee prices between late 2016 and late 2018 when the 'ICO composite indicator price' dropped by 31 % (ICO, 2019). Another report suggests that in Honduras around half a million people working in coffee live in extreme poverty (Bunn et al, 2018), while according to a World Bank report, up to seven out of ten households in Guatemalan coffee regions live in poverty and two out of ten in extreme poverty (Hernandez et al., 2014). Although these reports do not specify what is meant by poverty or extreme poverty, it was assumed that it was in line with the World Bank's international poverty line of people living with less than US$1.90 per day (World Bank, https://www.worldbank.org/en/topic/measuringpoverty, last updated April 16, 2021). Moreover, although the reports do not differentiate between smallholders and other types of coffee farmers, it can be assumed that smallholders and coffee workers are the most severely affected.

Given the downward trend in prices, the increasing severity of climate change, the COVID-19 pandemic, and political instability within producing countries, in the last 5 years, the poverty situation of smallholder coffee farmers is unlikely to improve. For example, the ICO study estimates that in Honduras, the declining coffee prices reduced the annual income of coffee farmers by 35% between 2016 and 2018 (ICO, 2019). In Guatemala, many smallholder farmers are not able to make the ends meet with rising production costs and low coffee prices, which has increased migration to cities and to the U.S.A (USDA Foreign Agricultural service, 2019a). Nicaraguan farmers are also facing the pressure of low prices and lack of access to credit, compounded by the political instability in the country. According to a USDA report, the coffee sector is "in the middle of the worst crisis of the last decade" (USDA Foreign Agricultural service, 2019b).

Dependency on Coffee

As expressed earlier in this report, the type of longitudinal or time-series data for any of the indicators investigated is very scarce. To assess the trajectory of smallholder household's dependence on coffee income, this type of data would have needed to be collected several times from the same families. Only one study was found with this information, which analyzed livelihood factors of the same households, between 2007 and 2013, in Guatemala and Nicaragua (Baca et al., 2013). The study conducted interviews with 22 Guatemalan and 15 Nicaraguan smallholder households, respectively. During this 6-year period, the authors observed a declining trend on the percentage of total income generated from coffee in both countries (Figure 5). In Guatemala, 44% of the households generated more than 80% of their income from coffee sales in 2007. This figure decreased to 6% of the households in 2013, with most households reporting income from coffee representing between 51 and 80% of total income in 2013. In Nicaragua, a decrease from 53% generating more than 80% of their income from coffee in 2007, fell to 11% in 2013. Most of the Nicaraguan households reported generating less than 50% of their income from coffee in 2013. Although there might have been some methodological discrepancies on how the data was collected during each of the years, possible reasons for this trend may be: 1) changes in coffee prices, 2) the proliferation of diversification projects in these countries during this period, and 3) the beginning of the coffee leaf rust epidemic in 2013.

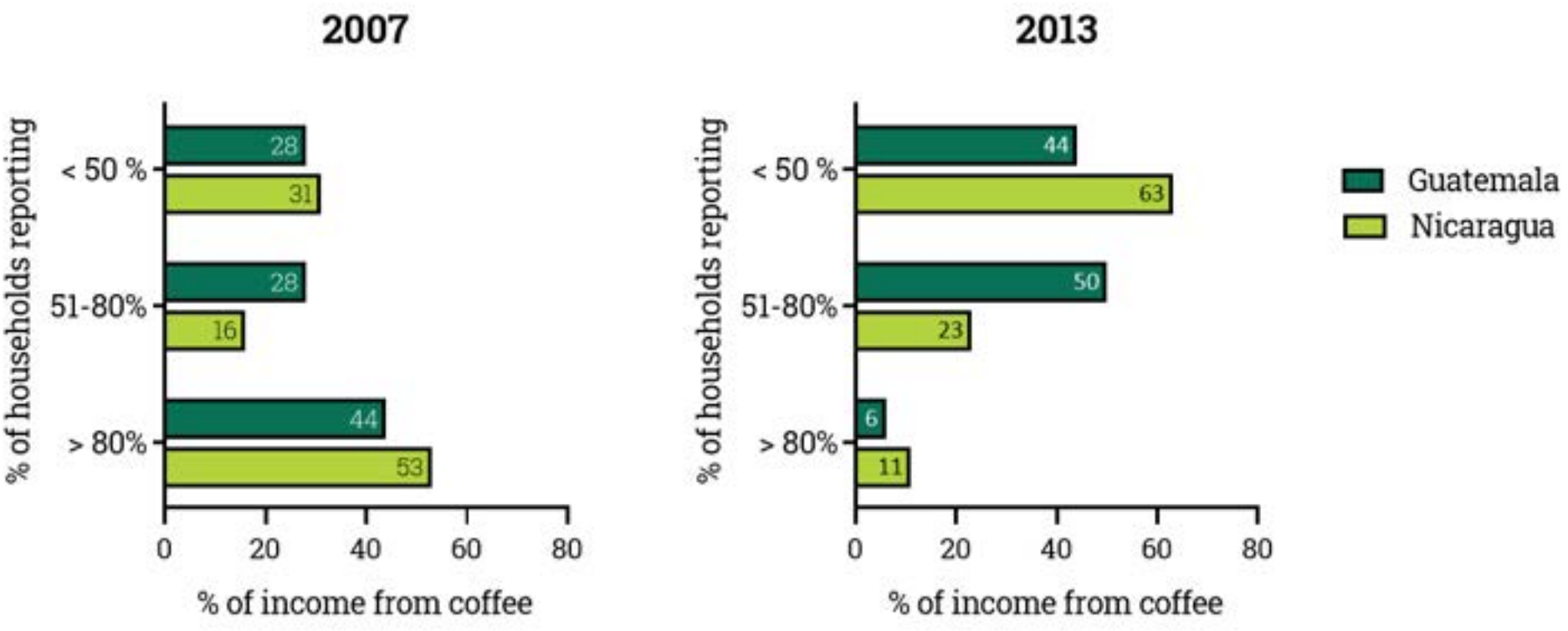


Figure 5. Longitudinal data on percent of households reporting income generated from coffee, between 2007 and 2013, in Guatemala (n=22) and Nicaragua (n=15). (Source: Baca et al., 2013).

Income Diversification

Income diversification in smallholder coffee farms is an important indicator that has been associated with building stronger livelihood strategies for coffee households (Anderzén et al., 2020). Given that smallholder farmers usually produce small volumes of coffee, a reliance on this crop, as the only source of income, results in financial vulnerability for these families (Méndez et al., 2010). Information for two relevant metrics for this indicator were found, as discussed below.

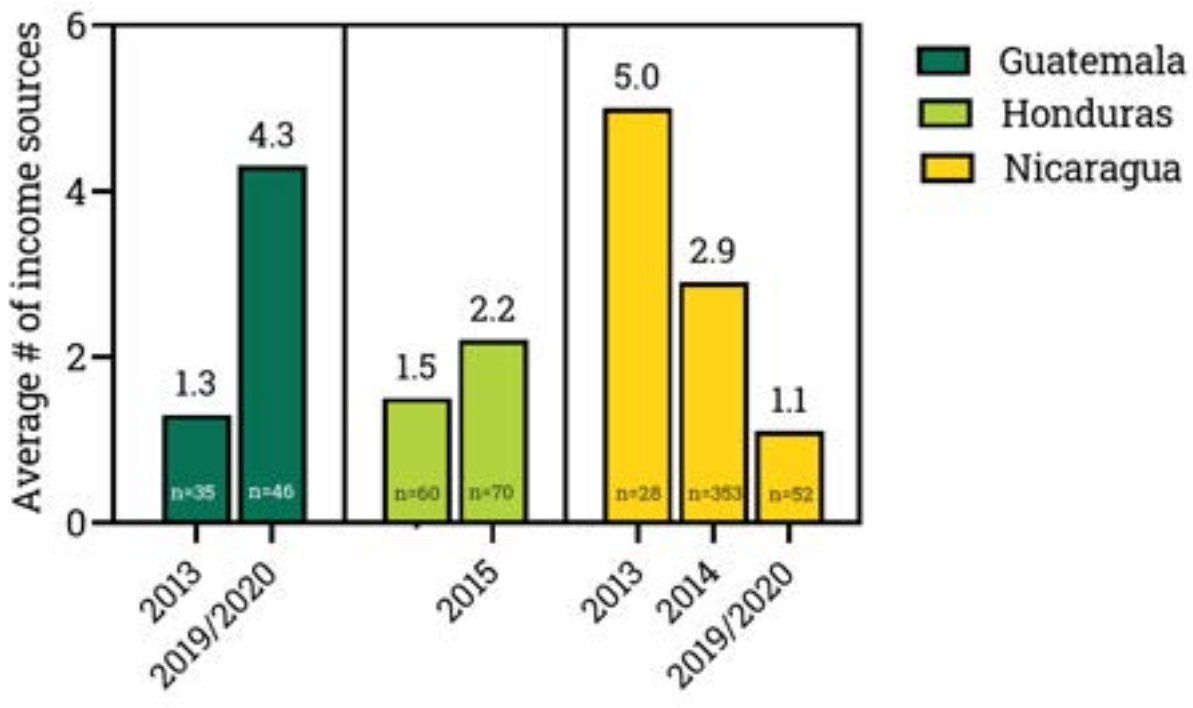


Figure 6. Average number of income sources for smallholder coffee farmers in Guatemala, Honduras and Nicaragua (2013-2019/2020). Each bar represents a data source, in the form of research, baseline, study, etc. Figures at the bottom of the bar (n=) represent the number of households interviewed per data source. (Sources: Baca et al., 2014; Bacon et al., 2017; Caravela Coffee, 2020; Caswell et al., 2016).

The first metric represents the number of income sources reported by households. This is a measure also used to assess livelihood diversification, in general, and increasingly in agroecology and resilience assessments (Caswell et al. 2014, 2016). This indicator signals the diversity of a family's income portfolio. A higher number of income sources tends to provide higher stability over time, as it mitigates severe impacts from decreases in one of the sources; in some cases, the opposite is true. In this situation, resource-poor farmers may be forced to seek various income-generating opportunities to make ends meet. For this indicator, 7 studies surveying smallholder households were found - two from Guatemala (81 households in total), two from Honduras (130 households in total), and three from Nicaragua (433 households in total). As shown in Figure 6, the results for this indicator were dispersed, with no clear trends. The lowest value we found was 1.13 sources of income in Nicaragua (2019/2020), and the highest value, also reported in Nicaragua, was 5 income sources (2013). All other figures were somewhere in between for the three countries.

The second metric for this indicator was percent of income from coffee reported by surveyed households. Two sources of data were found, which together collected information from 773 households in Guatemala and Nicaragua. In general, these two studies showed a relatively high reliance on coffee as the main source of income for the families participating in these studies. One study reported that in Nicaragua, coffee represented, on average, 44.8 % of the annual income of the surveyed households (n=28 households), while in Guatemala the percentage was 43.7 % (n=35 households) (Baca et al., 2014). Another study, conducted among the members of four Guatemalan coffee cooperatives, found that in three of the cooperatives, farmers obtained between 75 % and 82 % of their income from coffee (Root Capital, 2014); in one cooperative, the percentage was significantly lower (22 %). The income data were also broken down by gender, and generally, male-headed households had a higher annual income and received a larger proportion of their income from coffee than female-headed households. Many factors explain differences between the members of the four cooperatives, located in different parts of the country. For instance, families who received a lower proportion of their income from coffee, had other income sources as well, such as employment and other farm sales. In areas with high migration of men, female-headed households obtained less of their income from coffee and more from remittances (Root Capital, 2014). These examples illustrate that the contexts in which coffee smallholders are embedded are diverse, and generalizations based on case studies would be misleading. However, they give some indications that coffee continues to be an important source of income for many smallholder households.

Food insecurity

For more than a decade a number of researchers and organizations have been studying and reacting to food insecurity in coffee-growing communities across Central America. Several studies have documented the recurring cycles of seasonal food insecurity that many smallholder coffee farmers face. These often coincide with the rainy season, high price of staple crops, and income from coffee sales running out (Morris et al., 2013; Bacon et al., 2014; Fernandez and Méndez, 2018; Anderzén et al, 2020; Bacon et al., 2021).

For the period of 2013-19, several sources that included information about food insecurity in Guatemala, Honduras, and Nicaragua were identified. Although there is likely some variation in how 'thin' or 'lean' months (or months of food insecurity) were defined in these studies, five sources documented a percentage of farmers facing seasonal food insecurity (see Figure 7). The proportion of farmers who reported having experienced food insecurity varied between 35 % and 96 % . The sources containing information about the food insecure months show that the average length of seasonal insecurity in Guatemala was between 0.2 and 2.8 months, while in Honduras it ranged from 1.5 to 2.1, and in Nicaragua from 2.2 to 3.2 months (Baca et al., 2014; RHoMIS, 2015; Caswell et al., 2016; Root Capital, 2014; Bro, 2020; Bacon et al., 2021; anonymous, n.d.). A long-term research project conducted surveys in 2014 and 2017, with the same group of farmers in Nicaragua, seeking to study both food and water insecurity ('months of perceived water scarcity'). The surveys found that, while there was a slight decrease in both food and water lean months between 2014 and 2017, 96 % of households reported experiencing food insecurity and 71 % water insecurity in 2017, suggesting that both are persistent stressors among these coffee farmers (Bacon et al., 2017, 2021).

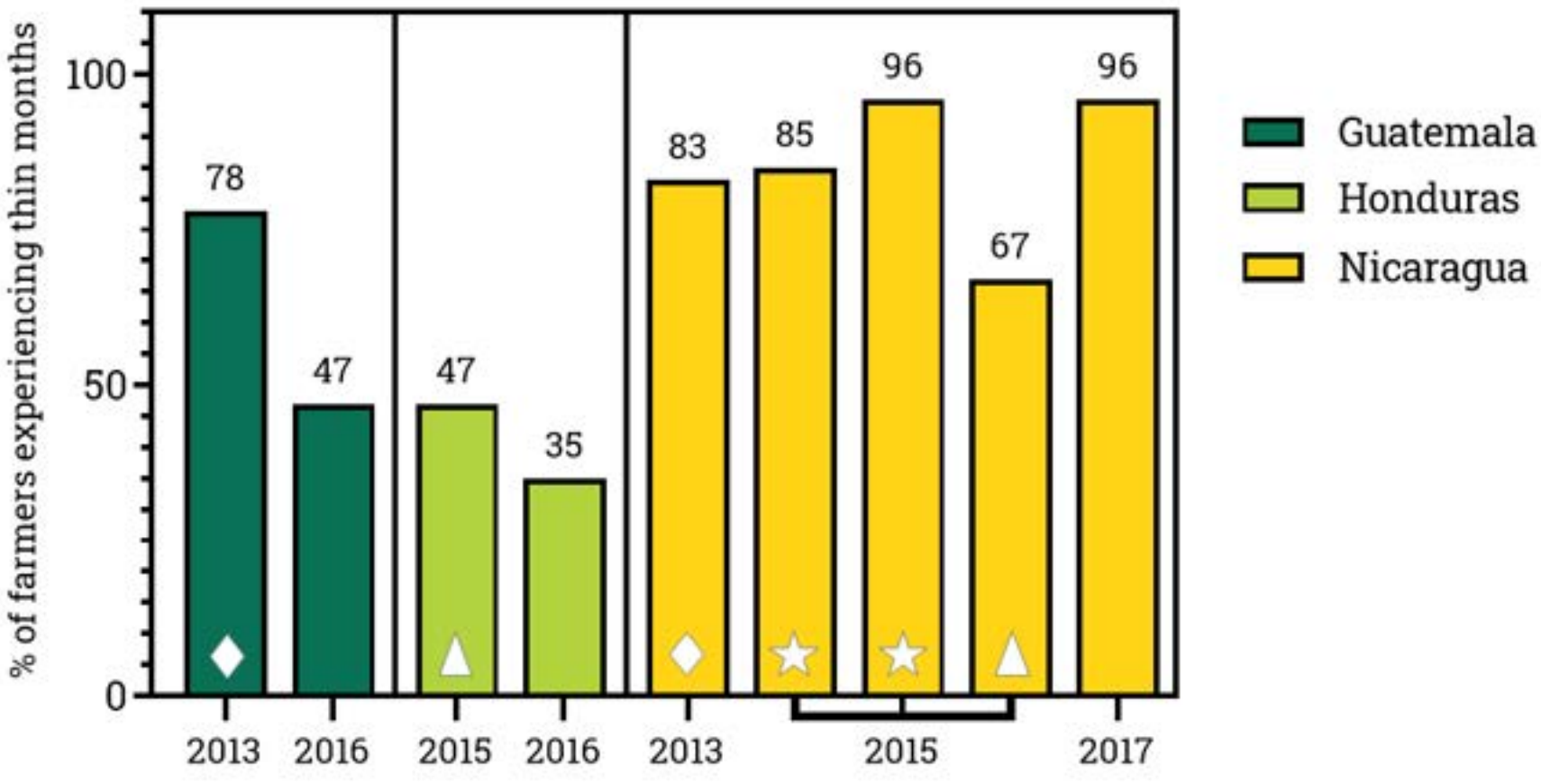


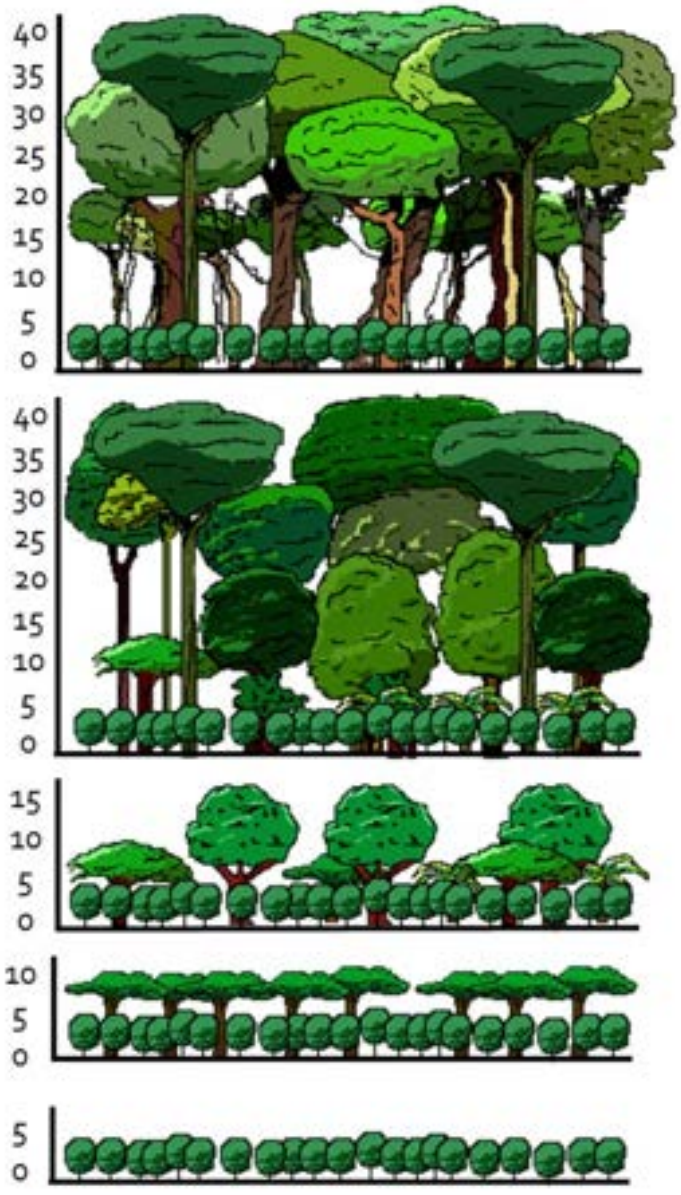
Figure 7. Percentage of farmers reporting food scarcity ('thin months') in five studies conducted in Nicaragua, Honduras, and Guatemala (Baca et al., 2014; Caswell et al., 2016: Bro, 2020; Bacon et al., 2021; anonymous, n.d.). The bars marked with the same symbols are from the same study - diamond: Baca et al., 2014; triangle: Caswell et al., 2016; star: Bro, 2020. In a study conducted by Bro (2020), more female respondents (96 %) reported experiencing food insecurity than men (85 %).

It is important to note that data about thin months only give some indications of a complex issue (food insecurity) that takes many forms in different contexts. Therefore, we recommend that the readers visit, whenever possible, the original sources and the online platform to gain a better understanding of food (in)security in specific coffee regions.

4.3 Environmental characteristics and contributions of shade-coffee agroforestry systems

Shaded Coffee Production

Smallholder farmers in Central America typically grow coffee in different types of agroforestry systems. These range from traditional rustic and polyculture systems, where coffee is generally grown under a multispecies and multilayered canopy of native trees, to more commercial or 'modern' systems where the native forest is removed and coffee is grown under planted trees (Toledo and Moguel, 2012; see Figure 8). The latter include shade monoculture systems containing a single shade tree species (Toledo and Moguel, 2012). Research shows that the more agrobiodiverse, traditional coffee systems generate many essential ecosystem services that provide resistance to climate change and contribute to farmer households' food and livelihood security (Toledo and Moguel, 2012; Jha et al., 2011; Perfecto and Vandermeer 2015). They can also act as a 'refuge' (Perfecto et al., 1996) for the conservation of a variety of tropical species that, in addition to creating favorable growing conditions to coffee, can be used for food, timber, firewood and medicine (Jha et al., 2014; Perfecto and Vandermeer 2015). However, while diverse coffee agroforestry systems provide important benefits to the environment and humans, they cannot fully replace primary forests. Hence, it is also important to remember that coffee production has contributed to high deforestation rates in Central America in recent decades (Bunn et al., 2018; Bunn et al., 2019).



Some estimates about the share of shade coffee in Honduras, Guatemala, and Nicaragua were found. According to IHCAFE, around 98 % of Honduran coffee is grown under shade (IHCAFE, 2017), while another source reports 95 % (Álvarez, 2018). Also in Guatemala, nearly all coffee (98 %) is grown under shade (Anacafé, 2019), while in Nicaragua the estimated percentage of shaded coffee is 96 % (Villarreyna Acuña, 2016). However, these sources do not specify what type of shaded coffee agroecosystems predominate in Honduras, Guatemala, and Nicaragua; it is assumed here that both 'traditional' and 'commercial' systems exist, with the latter being more common. Accurate, regularly updated data on shaded coffee on a national level would be useful for decision-making, as up-to-date information on shaded coffee would allow an assessment of changes in land use, management practices, and biodiversity (see Harvey et al, 2021).

Figure 8. Classification of coffee producing landscapes. At the bottom, an unshaded monoculture, then four different types of shade-coffee systems, namely shaded monoculture, commercial polyculture, traditional polyculture ("coffee garden"), and a rustic system. (Source: modified from Toledo and Moguel, 2012).

Third-party Voluntary Sustainability Standards

Over the past decades, the coffee industry has seen the rise of numerous third-party voluntary sustainability standards (VSS), such as Fairtrade (FT), Rainforest Alliance and UTZ, which seek to enhance the social, economic, and environmental sustainability of coffee production (Grabs et al., 2016). Currently, approximately 35 % of coffee produced globally is certified, and that share is steadily increasing (IISD, 2019). Although the criteria for the certification schemes vary, all of them have standards regarding environmental stewardship. Therefore, data about the VSSs can provide some additional information about the share of smallholder coffee farmers who are applying management practices supporting some type of environmental conservation. However, this does not suggest that uncertified farmers are not applying similar practices, or that all the environmental standards of different VSSs are rigorous.

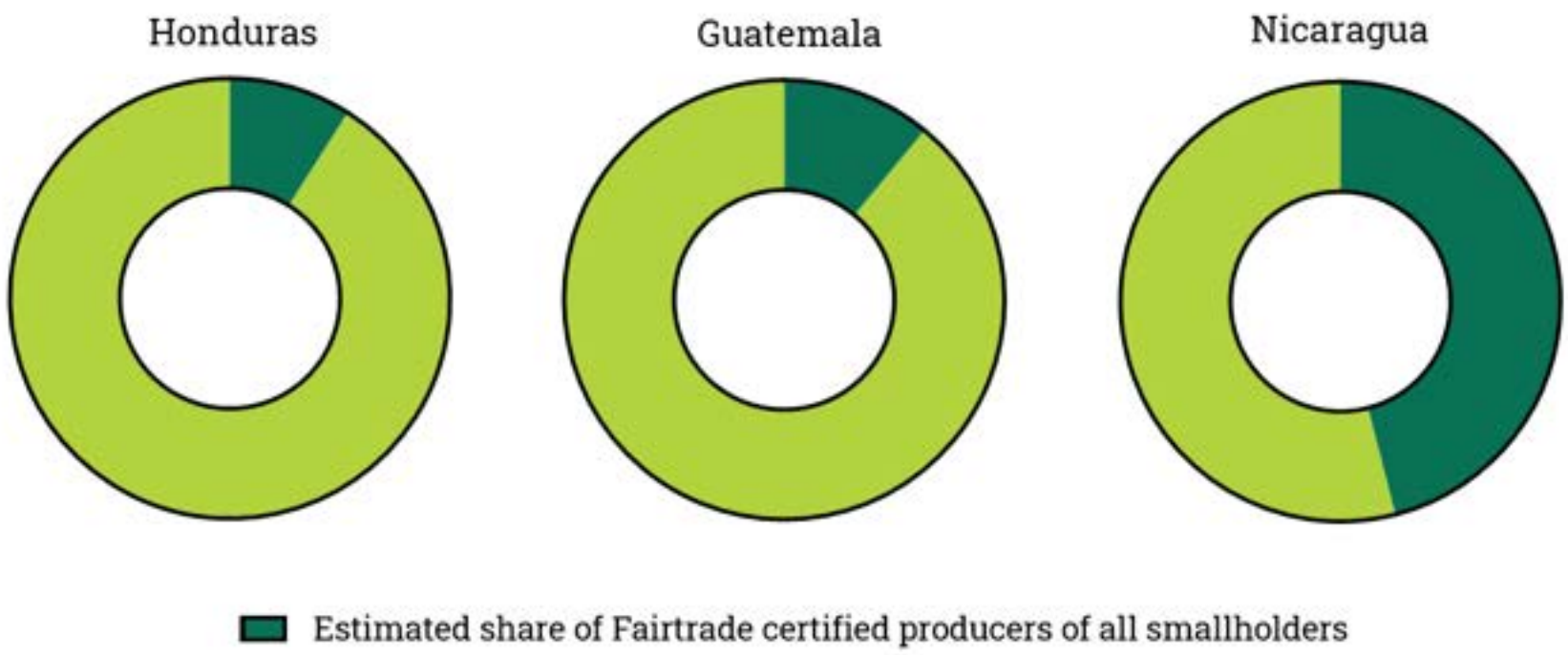


Figure 9. Estimated share of smallholder coffee farmers who are Fairtrade (FT) certified in Honduras (~9%), Guatemala (~11 %), and Nicaragua (~46 %). (Sources: Fairtrade International, 2017 for number of FT certified producers; ILO, 2020, Anacafé, 2019, and USDA Foreign Agricultural Service, 2017a for the number of smallholder producers in Honduras, Guatemala, and Nicaragua.)

In Honduras, the share of specialty and certified coffee has been increasing rapidly over the recent years due to higher demand (USDA Foreign Agricultural Service, 2021). IHCAFE estimates that the share of 'differentiated' coffees (certified and specialty) was 41 % in 2019 (IHCAFE, 2019). Another report notes that 19 % of Honduran coffee was certified in 2015/16: Fairtrade/organic accounted for 32 % of the differentiated coffees, while the share of UTZ was 24 %, Certified organic 17 %, Fairtrade 8 %, Rainforest Alliance 8 %, Starbucks Café Practices 6 %, and others 5 % (Bunn et al., 2019). In Nicaragua, around 30 % of all coffee is certified, with UTZ/Rainforest Alliance, Fairtrade, and organic being among the most prevalent VSSs (Wiegel et al., 2020). As for Guatemala, the data-gathering efforts for this pilot were not able to identify data about the proportion of certified coffee of the total production or the relative importance of different VSS; however, scattered data points were found that provide some information

about the status of certifications in Guatemala. For instance, a study from 2016 found that, depending on the region, certified coffee occupied between 30 % and 1 % of the Guatemalan coffee areas (Grabs et al., 2016). Another source informs that most of the organic agriculture in Guatemala is coffee (90 %). However, only around 1 % of all coffee production is certified organic, as the organic certification remains too expensive for most smallholders (USDA Foreign Agricultural Service, 2017b).

Farmer holding freshly picked coffee berries in Guatemala. Credit: Heifer International/Phillip Davis.

Fairtrade International is one of the few certification bodies that specifically works with smallholder farmers, typically through small-scale producer organizations. Fairtrade USA, however, works with larger producers as well. Fairtrade International's recent publication shows that in 2018, Honduras was the second largest producer of Fairtrade (FT) coffee in Latin America, while Nicaragua held the fifth and Guatemala the seventh place (Fairtrade International, 2021). In 2017, there were 9,083 coffee farmers producing FT coffee in Honduras, 12,948 in Guatemala, and 19,657 in Nicaragua (Fairtrade International, 2019). By using the number of smallholder producers presented in section 4.2.2, an estimate of the percentage of FT certified farmers of all small-scale coffee producers can be calculated (see Figure 9). According to this estimate, approximately 9 % of Honduran smallholders produce FT coffee, while the percentage is roughly 11 % in Guatemala, and 46 % in Nicaragua. As said, this is a very rough estimate, as it is likely that the numbers of FT farmers include some medium-sized farmers (see certification standards; Fairtrade International, 2019). However, it provides some information, albeit imperfect, about the proportion of farmers applying management practices contributing to a "sustainable production system where risks to health and the environment are minimized and biodiversity is protected and enhanced" (Fairtrade International, 2019, p. 20).

Agrobiodiversity in Coffee Farms and Landscapes

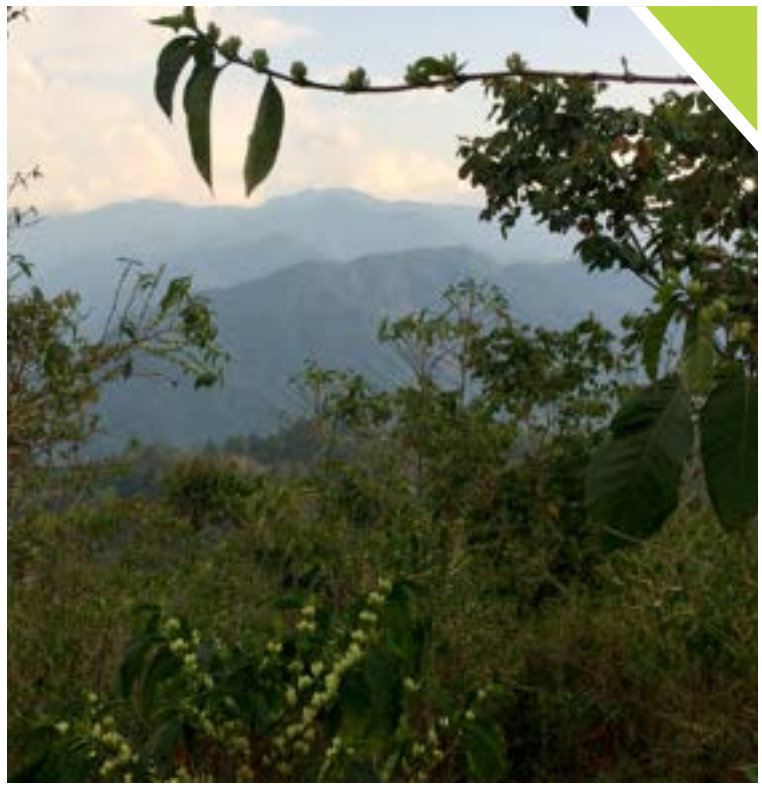
As discussed earlier (6.1.1.), smallholder farmers typically grow coffee in shade-coffee agroforestry systems, ranging from traditional agroforestry systems with a diversity of shade trees to more simplified shade-coffee plantations with less agrobiodiversity. In addition to coffee, small-scale coffee farms often include various other plots for other uses, such as milpas for basic grains or pasture for cattle. This constitutes land-use diversity at the farm level, which in turn contributes to broader landscape diversity (Jha et al., 2011; Anderzén et al., 2020; Méndez et al, 2010). It has been shown that agrobiodiversity provides multiple benefits to households, ranging from dietary diversity to additional income (Méndez et al, 2010). From an environmental perspective, diverse land uses can also provide different ecosystem services, sometimes in complementary ways, ranging from water regulation to rare species conservation and carbon sequestration (De Beenhouwer et al, 2013).

Several case studies have documented aspects of agrobiodiversity in coffee farms or communities by measuring, for instance, species richness (number of species in an area) or species abundance (number of individuals per species). Agrobiodiversity data are often analyzed together with other variables, such as months of food insecurity or income, to better understand the multiple contributions of agrobiodiversity to human or environmental wellbeing (Bacon et al., 2014, 2017, 2021; Anderzén et al., 2020). A high diversity and density of trees on farms and coffee plots remains a strong indicator of sound environmental management, with potential contribution to ecosystem services such as water regulation and carbon sequestration (De Beenhouwer et al, 2013). In addition, shade coffee plantations have long been seen as potential refuges for tropical diversity, both managed and wild (Perfecto et al, 1996; Jha et al., 2014). Hence in our analysis of the data, we paid special attention to the presence and diversity of trees in coffee farms and landscapes, as an indicator of environmental health.

Shade-coffee agroforestry system in Copán, Honduras. Credit: Ernesto Méndez.

This initiative found several studies documenting agrobiodiversity in smallholder coffee farms, but these were hard to compare due to the different methods and variables that were utilized in each case. In one of the most comprehensive studies for Central American smallholder farmers (including coffee and others), Harvey, et al. (2017) measured tree species diversity in coffee plots in two Guatemalan locations (for a total of 62 farms) and one Honduran site (29 farms). In Guatemala, the sites had mean values of over 5 and 10 tree species, respectively. In Honduras, the one site analyzed contained over 8 tree species, on average. In Guatemala, fruit tree species represented almost 38% of the mean tree species found in one site, and over 28% in the second site. In Honduras, fruit species represented over 53% of the mean tree species found.

There is also a growing body of studies that have documented relations between agrobiodiversity and food security and sovereignty. For example, Bacon and others found that the smallholder farmers they surveyed (n=363) in Northern Nicaragua had, on average, 157 nut or fruit trees on their farm. The abundance of nut and fruit trees correlated with the number of 'lean' months, that is, a higher number of trees was associated with fewer months of food insecurity (Bacon et al., 2017). They found a similar association in an earlier study conducted in the same region (Bacon et al., 2014).



Coffee plantation at dusk in Chiapas, México. Credit: Janica Anderzén.

Carbon Sequestration in Shade-coffee Systems

In addition to other essential ecosystem services that shade-coffee agroforestry systems provide, these systems function as carbon sinks, thus contributing to climate change mitigation (Soto-Pinto et al., 2010; Jha et al., 2011). As a perennial plant, coffee typically serves as a relatively stable carbon sink throughout its life, while shade trees significantly increase carbon stocks (ASB, 2011). Growing scientific evidence shows that shaded coffee systems – especially systems resembling the forest structure – maintain significantly higher carbon stocks than unshaded monoculture plantations (Soto-Pinto et al., 2010; Perfecto & Vandermeer, 2015; van Rikxoort et al., 2014; Zaro et al., 2020). As an example, a study from southern Brazil found that coffee grown in full sun stored, on average, 30.48 Mg C ha-1 (Megagrams of carbon per hectare, Zaro et al., 2020), while diverse shaded coffee agroforestry systems have been shown to store up to 213.8 Mg C ha-1 (total carbon) (Soto-Pinto et al., 2010). Moreover, one of the few longitudinal studies on C sequestration and tree species conservation in shade coffee, showed that a smallholder cooperative in El Salvador under traditional shade, maintained tree biodiversity and almost doubled aboveground C stocks, over a 9-year period (Richards & Méndez, 2014).

Even though there is an increased interest in documenting carbon sequestration in coffee systems, few studies were found from Honduras, Guatemala, or Nicaragua between 2013 and 2019. A study from Nicaragua compared a full-sun coffee plantation with three types of shade-coffee agroforestry systems. They found that carbon stocks in aboveground biomass (not total carbon) varied from 8.8 Mg ha-1 in full-sun plantations to 38.6 Mg ha-1 in the most diverse shade-coffee system (Pinoargote et al., 2017). Another study conducted in Jinotega, Nicaragua, discovered that the sampled plots (n=70) stored on average 160.10 Mg C ha-1. Plots with more diverse shade vegetation and a high density of trees stored slightly higher levels of carbon (Kichline, 2017). Finally, an older study, conducted between 2007 and 2010 in the Department of Sololá, Guatemala, shows that the total carbon stored by densely shaded polycultures ranged from 74.0 to 259.0 Mg C ha-1, with a mean of 127.6 Mg C ha-1 (Schmitt-Harsh et al., 2012). The findings from these studies are in line with similar studies (see Kichline, 2017 and Pinoargote et al., 2017 for an overview).

Many factors contribute to levels of carbon storage, including age of shade trees, tree species, climate, and management practices. For instance, management practices that prevent soil erosion can also help conserve carbon stocks in soil (Soto-Pinto et al., 2010). Deforestation and reduced biodiversity in shade systems, in contrast, can result in loss of carbon and increased emissions of greenhouse gases (Kichline, 2017). This is an important consideration, as climate change and other stressors drive changes in land use and/or coffee farming practices. Carbon payment programs or Payment for Ecosystem Services (PES) schemes could encourage farmers to manage coffee farms that support carbon sequestration and mitigation of greenhouse gas emissions (Richards & Méndez, 2014; Kichline, 2017). More research is needed to document the contributions of shade-coffee agroforestry systems - typically managed by smallholders - to local and global climate change mitigation.

Soil Conservation and Agroecological Practices

Soil conservation and agroecological practices have become more important across the coffee value chain because: 1) they connect to coffee farm resilience, which in turn links to coffee supply resilience and stability up the chain; and 2) many of these practices are required as part of existing sustainability standards and certifications (i.e., FT, Rainforest, Organic, etc.). In addition, there has been an acute awareness of the risk for soil erosion, and hence the need for conservation practices, in the mountainous terrain that predominates in coffee producing regions. There is also evidence that this type of management is conducive to higher sustainability and resilience in the long-term.

This was one of the categories with the highest number of indicators found, with a total of 34 different indicators. These ranged from traditional soil conservation practices, such as terracing and barriers, to treatment of household and coffee wastewater. Most of the studies measure the percentage of farms surveyed that implemented a specific practice. The raw data on practices we have collected for the platform will be useful for those working with this particular focus, and we encourage them to further explore these indicators through this venue. Given the high number of indicators, we decided to analyze and discuss those that could provide a bigger picture of the use of conservation or agroecological practices in coffee farms. Thus, this section focuses on analyzing reports that recorded the number of agroecological and/or conservation practices present on-farm and the area that they covered.

Chicken in the backyard of a coffee farmer family in Chiapas, Mexico. Credit: Janica Anderzén.

A relatively recent study by Caswell et al. (2016) focused on 8 agroecological practices (ranging from agroforestry to coffee renovation), within 4 types of land use, at sites in Nicaragua and Honduras. This means that a farmer could manage up to 32 agroecological practices if they applied all 8 of the practices in the 4 different land uses identified. In both sites, researchers separated farmers surveyed into two groups or types- small and less diverse and larger and more diverse. At all sites farm sizes were below 3 ha. The small/less diverse farmers managed, on average, 5.5 and 5.6 agroecological practices in Honduras (37 farms) and Nicaragua (40 farms), respectively. The larger/more diverse farms managed, on average, 11.9 and 10.7 agroecological practices in Honduras (23 farms) and Nicaragua (30 farms), respectively.

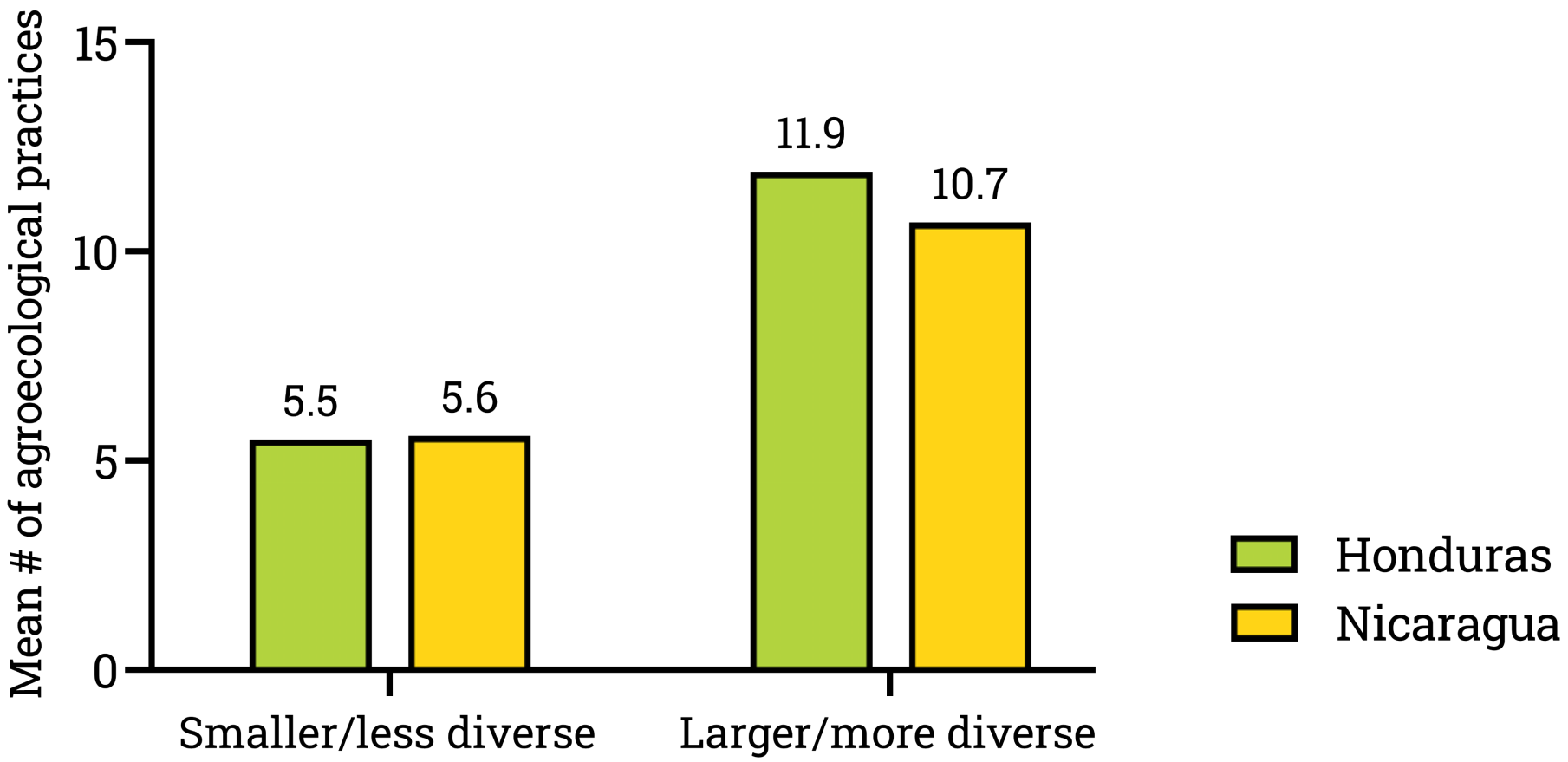


Figure 10. Mean number of agroecological practices in different types of smallholder farms in Honduras and Nicaraga. The types of farms were smaller/less diverse (Honduras n=37, Nicaragua n=40) and larger/more diverse (Honduras n=23, Nicaragua n=30) (Source: Caswell et al., 2016.)

In another comprehensive study by Harvey et al. (2017), researchers analyzed 10 'Ecosystem-based Adaptation (EbA)' practices, which were very similar to the practices examined by Caswell et al. (2016), mostly focused on agroforestry and soil conservation. In this research, the Guatemalan sites had an average of 2.8 and 3.7 EbA practices, respectively, and in Honduras, the average was 5.4 practices.

Harvey et al. (2017) also calculated the area, in ha, where EbA practices were present. We can observe that the areas were small: 0.07 and 0.12 average hectares in two sites of Guatemala, and 4.44 hectares in Honduras. Although this is to be expected given that farm size averages for both countries were below 4.5 ha, we do observe a trend that larger farms in Honduras had more area under EbA practices, as well as more practices. This aligns with a higher number of practices in larger farms of Honduras and Nicaragua in the study by Caswell et al. (2016). Although farm size may be more conducive to the adoption of agroecological and other sustainability-oriented practices, other factors that may affect this include certifications and cooperative membership. The latter is further affected by the type, mission, and origins of cooperatives (Méndez et al., 2009).

5. Interviews with Actors Working with Smallholder Coffee Farmers

5.1 Data collection, availability, and management

Nearly all of the organizations that the project team talked to collect some data on smallholder coffee farmers, although the drivers, objectives, and frequency of these efforts vary. Data is collected to measure and assess impacts of projects and sustainability commitments, monitor compliance with standards, inform decision-making, and advance scientific understanding. For instance, organizations implementing projects and programs in coffee communities typically use a variety of tools to plan, monitor, and assess their interventions. Coffee companies, on the other hand, regularly collect transactional data that inform their business-related decisions. For researchers in the universities and research institutes, data collection is an integral part of the scientific pursuits that allow them to advance knowledge on coffee systems and farmers. Finally, some organizations specialize in developing assessment tools and common indicators, and offer their services to others.

5. Full dataset for this study can be found in Dataverse: Characteristics and use of EbA practices by smallholder farmers in Central America (2018).

While some actors said they were “drowning in data”, others noted their data collection was relatively limited. At the same time, it was not always clear what kind of data might be available about smallholders, or if it would be useful to this project. The uncertainty about data availability was true especially for larger organizations with several units involved in data collection. Generally, everyone seemed to agree on the importance of collecting data; yet, it was seen as time-consuming and expensive, and many struggled with limited human resources in processing and systematizing the existing data. As one person noted, “data are like a river, they are constantly changing”, which means that organizations need to update their data frequently, in order to keep it relevant. This can be taxing, especially for smaller organizations. Therefore, many organizations are collaborating with other actors, such as universities, or bought services from organizations specialized in data collection and management. There were also concerns about the burden that frequent and sometimes overlapping data collection efforts can put on farmers and their organizations. Again, collaboration among various actors could reduce the burden on producers.

> *My problem is not a lack of data, my problem is I have too much data. Often enough, I'm basically drowning in it.*

5.2 Variability and quality

The organizations that the team talked to collect data on a variety of economic, social, and ecological aspects, mirroring the diversity in the mission and scope of these actors. Examples include production costs of coffee, living income, coffee sales, sustainable farming practices, climate change adaptation, and food insecurity, among others. Data are collected mainly in quantitative form, although some actors told us that they also gather qualitative data (e.g., in the form of stories). One overarching theme that resonated throughout these discussions centered around lack of standardized indicators. Similar indicators or metrics are often used to measure the same (or similar) phenomena, which many saw as problematic in terms of comparability or benchmark setting. This occurs especially when multiple indicators are needed to measure or understand complex concepts, like true costs of coffee production or climate change resilience. On the other hand, some noted that harmonization/standardization of indicators can hide important nuances among different contexts in which smallholder farmers produce coffee, but we need a diversity of indicators to understand and represent complexity.

The quality and robustness of data raised a lot of discussion. As many pointed out, data and information need to be informative, reliable, and current in order to be useful. There are many factors that can negatively affect the data quality and reliability, such as inexperienced

people/organizations conducting data collection, lack of metadata, and indicators taken out of context. Some perceived small sample sizes as tricky, since they only describe the conditions of a small group of farmers in a specific context. Some were also raising questions about biases in collecting and sharing data. They noted that some organizations may be reluctant to gather and/or present data on sensitive topics that might make them look bad or are only interested in data that can benefit them directly. Therefore, the available data and information paint only a partial picture of the realities of smallholders, and can create "asymmetries in information", as one person from a producing country noted. This is problematic, as data holds a lot of power, and many assumptions are made based on available data and information.

5.3 Sharing Data

In the conversations, people were asked about data or information that they could potentially contribute to this initiative. This prompted a variety of responses, and we found that there was no clear-cut process to share data. Although most actors agreed that sharing data and information can generally be useful and reduce the burden of data collection, several issues needed to be taken into consideration. A common theme was the existence of various legal issues and internal policies regarding data sharing. A few organizations said all their data is publicly available and could be shared without major caveats; others were generally not certain what the policies and procedures were in their organizations, or the guidelines depended on the type of data. Some actors were not sure about the ownership of the data whenever the data collection was funded by donors; for a handful of organizations, the data and information they hold is closely related to their business model, and therefore cannot be shared. Some actors said they have data that they use internally, but do not typically share even in their own reports.

> *How can those who are contributing data and indicators shape the agenda... How can we come together and use this for the greater good of smallholder coffee producers?*

Many hesitations arose in regard to anonymizing data. All groups care deeply about protecting the identities and personal information of the farmers that participate in data collection. There was a concern for protecting farmers' privacy, whenever sharing potentially identifiable data or information. Another concern that organizations had was if farmers would benefit or find value in their data being shared with others. As some pointed out, the data belong to the farmers and any information they share should be used in a way that generates actionable outcomes. There was also discussion around "imperfect" or "incomplete" data and whether sharing such data or information could be potentially harmful. To summarize, most actors were uncertain about being able to share their data, and if it could, under which terms.

5.4 Data needs

Our conversations were eye-opening to a variety of data needs, ideas, and general thoughts on the State of the Smallholder Coffee Farmer Platform. Everyone recognized the importance of (good quality) data and information for better decision-making, and most agreed that this type of initiative would be useful. Some actors were cautiously optimistic, as they had seen similar initiatives rise and fall in the past. Having clarity on the objectives and long-term plans of the initiative, as well as the responsibilities of the users could help avoid some of the possible bumps along the way.

Organizations mentioned several benefits of having curated data or information stored in one place. It would make it easier to find and share specific data, and potentially decrease the burden of data collection both on farmers and the organizations working with farmers. This was especially true for those stakeholders in the coffee supply chain that do not collect farmer-level or regional data themselves. They noted that reliable and unbiased data could improve transparency and accountability along the whole coffee supply chain and reduce some of the information asymmetries that directly or indirectly perpetuate inequalities among stakeholders. When coffee farmers directly contribute information about their farms and conditions, the data should be used for "something good", as one person suggested. Those that have limited access to data could benefit from an open access platform. Some called for a shared responsibility among actors along the coffee value chain in terms of data sharing.

One key takeaway from these discussions was the lack of a standardized process regarding data collection and sharing. Many agreed that some level of harmonization of indicators could potentially make the data more comparable across time and contexts. However, they were aware of the challenges that the harmonization or standardization entail, such as the risk of simplifying and masking the diversity among coffee farmers and communities. Several specific data needs were mentioned, most of these involving economic aspects of coffee farming.

Bright red coffee berries, Guatemala. Credit: Heifer International/Phillip Davis.

These included:

- True costs of production.
- Living income.
- Economic viability of coffee production.
- Environmental contributions of small-scale coffee farms (e.g., carbon sequestration).

Some also suggested that, in addition to data, the platform could include a variety of data collection instruments that different actors have developed.

> *What data there is may be difficult to find or not something that is publicly available [---] if we the industry say 'we want to know this and value this', we should be prepared to pay for that sort of data or to demonstrate that we value this. Because I think that is sometimes missing - how valuable this data is.*

6. Discussion

In the previous sections, a vast amount of data - found through a data search and interviews - was synthesized. This offered insights about some of the socioeconomic and environmental characteristics of smallholder coffee farmers in Nicaragua, Honduras, and Guatemala, as well as the challenges they face. However, it is important to keep in mind that there are roughly 266,000 smallholders in these countries, and while they share many similarities, their farms, households, and livelihoods are all unique in their own ways. In this section, selected and interrelated findings from our data search are compared with studies from other regions. The importance of each of the indicators is discussed, as well as the role of the platform to generate and provide access to data on smallholder coffee farmers, which is meaningful and useful to diverse actors in the coffee value chain. In addition, possibilities to apply an agroecological approach to this work in a future iteration are discussed. Finally, lessons learned are shared from the process of developing the platform and from interviews with diverse actors across the coffee value chain.

6.1 Comparative Analysis

Although an extended discussion of the data presented in this report, in relation to other research, is beyond the scope of this pilot, this section reviews some of the findings with selected studies. Interrelated indicators from the platform were chosen to illustrate the potential to begin to better understand the complex reality of smallholder coffee households. In the future, this is one of the opportunities that an improved, dynamic, more harmonized and up to date platform could offer- the possibility to better compare and learn from data comparisons across contexts and regions.

Income diversification

Income and livelihood diversification are increasingly seen as key components to improving the well-being of different types of smallholder households (Kremen et al., 2012), including coffee producers (Anderzén et al, 2020). In comparing income diversification with studies in Mexico and El Salvador, similar figures were found to those from the data in Guatemala, Nicaragua and Honduras. A recent study from a cooperative in Chiapas, Mexico reported a range between an average of 1.7 and 4.2 income sources, dependent on the type of livelihood strategies the farmers were engaging in (Anderzén et al, 2020). This is a very similar range to what was found for Guatemala (range of 1.3-4.3) and Nicaragua (range of 1.13 to 5). Honduras was lower, with a range between 1.5 and 2.2 income sources in two sites. In El Salvador, farmers from a smallholder cooperative reported a range of between 2 and 6 income sources, including coffee (Morris et al., 2013).

Diversification is important because it counteracts industrial-inspired production models that would have smallholders focusing only on coffee. Given the small volumes produced by many of these households, it is important that they have buffers to support them when coffee production or prices are not favorable. Of special importance is the strong link between diversification and food security and sovereignty, a topic discussed in the next section. Higher diversification has been linked to higher levels of food security by several studies. Maintaining comparable data, as could be done through future iterations of the platform, is really important to be able to assess the benefits and challenges of different types of diversification initiatives across coffee regions.

Beekeeping workshop in Chiapas, Mexico. Credit: Food 4 Farmers.

Food security and sovereignty

As consistently shown by an increasing number of reports, mostly from Latin America, seasonal food insecurity is one of the key challenges smallholder coffee farmers face annually. A combination of weather, prices of coffee and corn (an important staple crop), and timing of coffee payments combine to affect a household's capacity to meet its food needs, anywhere from 1 to several months throughout the year. The data found for Guatemala, Honduras and Nicaragua was similar to reports from Mexico, which show a range between 1.3 and 2.8 lean months (Anderzén et al, 2020). In El Salvador a small number of families reported being food insecure all year, but there were peak periods when most families reported lean months (between December and February, and between June and September). In most cases lean months occur more frequently during coffee harvest (before payment), and before the staple crop harvest. This was also the case in Mexico, although dates change relative to the time of coffee and grain harvests, which are affected by elevation and rainfall.

Several of the indicators found through our data search provided important information on seasonal food insecurity, such as the number of farmers reporting it, the average number of 'lean' months that families suffer, and the periods when hunger is most severe. This data is of great relevance to the wellbeing of smallholder families. Tracking these indicators annually and longitudinally could provide useful information for initiatives fighting hunger in the coffee lands. The information from the individual studies and reports provides strong evidence that, while the coffee industry continues to grow, many smallholder households sustaining the industry are not able to meet some of their basic needs. This suggests that the prosperity in the industry is not trickling down, and that specialization in coffee may be negatively affecting coffee farmers' food security and sovereignty. Declining coffee prices are likely to exacerbate the situation along with other stressors, such as increasing costs of production and failed staple crop harvests due to climate change (Fews Net & Promecafe, 2019)

Agrobiodiversity in coffee farms and landscapes

Levels of agrobiodiversity, measured through shade tree species diversity (ranging from 5 to 10 species) in Guatemala and Nicaragua, are in line with similar studies across Latin America and Asia. In a study in Chiapas, Mexico average tree diversity was 8, but with a higher range (1-18) (Valencia et al., 2014). A study in El Salvador found higher levels of diversity with a range of between 12 and 22 average shade trees species across three cooperatives (Méndez et al., 2010). In perhaps the most comprehensive analysis of shade tree diversity across Latin America, Philpott et al. (2008) reported a range between 3 and 12 average shade tree species on farms, across Mexico, Peru, Guatemala, and Nicaragua.

Agrobiodiversity can be seen as a management strategy as well as a particular characteristic of a farm. It is affected by both ecological and human-induced processes. A growing body of work points to higher levels of agrobiodiversity as beneficial to both humans and landscapes in tropical regions (Jha et al., 2014). Most smallholder coffee farmers cultivate their plantations as diverse agroforestry systems which provide a variety of ecosystem services (De Beenhouwer et al, 2013). A high number of shade trees and species is perceived by most researchers as an indicator of a healthy system, although it may affect coffee yields (Jha et al, 2014). From the perspective of the smallholder household, higher agrobiodiversity can support food security and nutrition for families, as well as generate income. As argued by Jha et al (2014), levels of agrobiodiversity in coffee plantations (including smallholder farms) have shown an overall decline since 1996, so it is important to explore creative ways to support farmers to maintain this important resource.

6.2 Lessons learned from the data search and interviews

The process of data search and conversations with actors working with coffee smallholders provided many insights about the availability and quality of data. It also helped identify some gaps and limitations as well as opportunities for improvement. Some of the key lessons learned through the process are summarized below:

Publicly available data and information are limited. The systematic search carried out as part of this pilot yielded fewer results than was expected. While many organizations and actors working with coffee smallholders collect and store data about coffee farmers (for varying purposes), a lot of the data and information are not made publicly available. Even organizations that put a lot of resources in data collection are sharing relatively little data or information through their websites. This begs the questions - how can we know, for instance, if some of the multi-stakeholder initiatives are having the desired impact?

There are barriers to accessing data. Even when the data or information are made public, it can take significant effort to find them on the websites. Publications or other sources are often stored in different sections of the organization's website, and it can take time to browse through various pages (it's easy to miss great sources!). In some cases, access to information is limited to certain user groups only, such as members of an organization. For instance, scientific research is typically published in academic journals that – unless they are open access – require an affiliation with an academic institution or a subscription. There are some notable exceptions, such as Dataverse that allows academics and others to share and access data easily, while still protecting the anonymity of farmers sharing their personal information. Finally, a lot of the information about the lives and livelihoods of coffee producers is published in English, which creates access barriers to the farmers and their organizations.

Coffee beans drying in the sun, Guatemala. Credit: Heifer International/Phillip Davis.

"Same, same, but different". There is a lot of variability in the indicators and metrics that are being used. Although many indicators appear to be similar, they are not exactly the same, which makes it difficult to compare or aggregate data. The lack of standardization can be

particularly problematic with composite indicators (composed of several indicators) that are used to guide decision-making – for example, costs of production can be calculated either very narrowly or by taking into consideration a detailed set of variables. There are some efforts to harmonize/standardize indicators, such as the master list of COSA, which have the potential for creating more clarity around a set of key indicators.

Lack of longitudinal data. Another key issue identified during this pilot is the lack of longitudinal data, i.e., data collected from the same respondents at different points in time. Most data found were collected using household surveys. These surveys, often conducted once, provide a valuable "snapshot" of certain aspects of a group of coffee farmers at a specific moment in time. However, to analyze trends or evaluate change over time – for instance, after a major event, such as a price crisis – more longitudinal data is required. Long-term collaborations with farmer organizations and actors specialized in data collection could be a step towards collecting and systematizing this type of data.

6.3 Connecting indicators with agroecological principles

Agroecology is a holistic approach that builds from the science of ecology to better understand and transform food systems. At the core of agroecology is the goal of achieving food systems that are ecologically sound and socially just (Méndez et al, 2015). In the last decade, the field of agroecology has grown exponentially, and it has been adopted by a variety of actors, including academics, farmers, and social movements (Anderson et al, 2021; Mason et al., 2021). There is also a long history of agroecology work with smallholder coffee farmers (see for example the work of the ALC over two decades, and a recent book on Coffee Agroecology by Perfecto & Vandermeer, 2015). It is this connection that inspired the inclusion of this section, as there is an opportunity to bring the agroecology approach to a data-focused effort for smallholder coffee regions.

The agroecological approach keeps actors focused on the steps and actions to achieve the ultimate goal of sustainable food systems, where principles and indicators have the role of showing strengths and limitations in specific areas (e.g. social contributions or ecological impacts; Méndez et al., 2020). In future iterations of this initiative, starting from agroecological principles could more strongly link work on the 'state of the smallholder' to an agroecological approach and the growing initiatives surrounding it. Of key importance to this effort is that it is a lot easier to compare principles across different geographies and contexts than more specific indicators (Patton, 2017). This connection and perspective could prove useful to a variety of actors along the coffee value chain and help guide and evaluate much-needed transformations in the coffee sector. Moreover, principles-based approaches can open more possibilities to "take people, environment and farming beyond terminology" (Caswell et al., 2021, p. 10), and let coffee farmers and their organizations define principles that are representative and relevant to develop ecologically, socially, economically, and culturally sustainable food systems.

Figure 11 presents a simple link between some of the indicators found in the platform and the principles of agroecology proposed by the CIDSE organization (CIDSE, 2018). The CIDSE framework was utilized here as an example, given its simplicity and the researchers' previous

experience with them. However, other approaches and frameworks can be equally useful, such as FAO's 10 Elements of Agroecology or the 13 consolidated agroecological principles by HLPE (FAO, 2018; HLPE, 2019; Barrios et al., 2020).

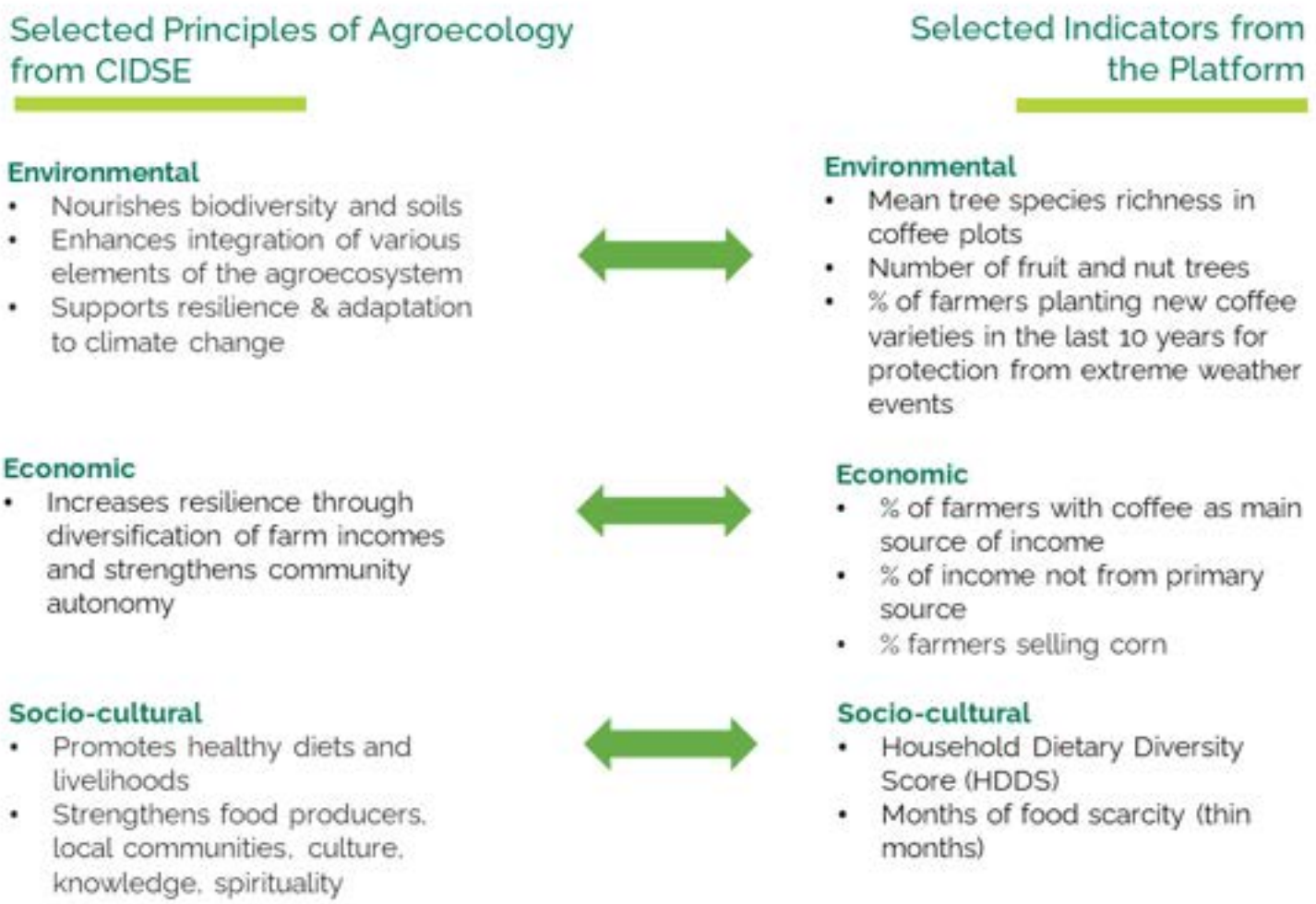


Figure 11. Alignment between agroecological principles and indicators curated in the State of the Smallholder Coffee Farmer platform (principles of agroecology CIDSE, 2018).

7. Conclusions

In this report, selected data on socioeconomic and environmental characteristics, contributions, and challenges of coffee smallholders from Honduras, Nicaragua, and Guatemala were synthesized. These data were also curated into an open access platform. The results reported here were analyzed, as examples of what can be done using the platform. The findings confirm the challenging social and environmental situation that smallholder coffee farmers and cooperatives continue to face. Data on diversification, food security, and agrobiodiversity, among others, show persistent trends, in the three countries and beyond, of households struggling to attain enough income, meet family food needs, and conserve important plant biodiversity.

Through an extensive data search and interviews with various stakeholders, it became clear that while there is a fair amount of data and information that can allow us to better understand the 'state of the coffee smallholder', there are also many gaps in the availability and quality of data. There are also serious access barriers that can prevent some users, such as coffee farmers, from viewing and using the information.

Coffee flowers. Credit: Janica Anderzén.

If the community of actors working with smallholder farmers wants to benefit from the wealth of data they and others collect and move towards a more equitable and democratic information landscape, more coordinated efforts are needed to improve the processes of collecting, systematizing, sharing and using data. Collaborations among various actors could strengthen these processes and reduce the burden of data collection and management on organizations, as well as farmers who provide the information. The State of the Smallholder Coffee Farmer Platform (https://coffeesmallholder.org/), along with this report, is one effort toward that goal. In the words of one of the actors we interviewed:

> *People get excited about data but lose to what end. The end has to be achievable and has to have value for those that the data will benefit.*

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Appendix I

List of actors who gave feedback about the initiative

	Organization	Non-profit	Research	Certification	Business/for-profit
1	Hanns R. Neumann Stiftung	x			
2	Conservation International	x			
3	Fairtrade International			x	
4	Planting Hope	x			
5	Sustainable Food Lab	x			
6	Símbolo de Pequeños Productores (SPP)			x	
7	The Committee for Sustainability Assessment (COSA)	x			
8	Root Capital	x			
9	Mercy Corps	x			
10	Sustainable Harvest				x
11	Ethos Agriculture	x			
12	Keurig Dr Pepper				x
13	Stumptown Coffee Roasters				x
14	Enveritas	x			
15	Specialty Coffee Association (SCA)	x			
16	Lutheran World Relief (LWR)	x			
17	Food 4 Farmers	x			
18	Heifer International	x			
19	CII-ASDENIIC	x			
20	UC Davis		x		
21	Equal Exchange				x
22	Coop Coffees				x
23	Caravela				x

Appendix II

Methodology for data curation

The curation of data for the platform (coffeesmallholder.org) included various steps and decisions, which are summarized in following:

1. Who are smallholders? Definitions for coffee smallholders vary from source to source. Unless the definition was not specified, we decided to include all farmers with less than 15 ha in coffee. Therefore, if the source did not specifically describe smallholders, we sought to disaggregate data whenever raw data was available. Most data sets include land areas and crops grown, so we could filter out larger producers and non-coffee farmers If the size of the coffee farm could not be determined, we did not include the indicator.

2. What or who the indicator applies to? The data can refer to a plot, all coffee plots, or all plots on the farm; to avoid confusion, we tried to be as specific as possible when naming the indicators included in the platform. Secondly, some indicators refer to individuals and some apply to the whole household. Where possible we disaggregated by gender of the individual and in certain cases, the household was disaggregated by the gender of the head of the household.

3. Naming and defining indicators. Indicators are generally worded differently in different sources, e.g., “Number of household members” and “Household size”. First, we needed to make sure if they were the same indicator or not. If they were the same, we gave them the same code and a general name, while also recording the original name. In the platform, any additional information that explains how an indicator is defined is recorded as the definition. When indicators are similar but vary slightly, they are included as separate indicators with separate codes.

4. Organizing the indicators. We used a hierarchical indicator classification system to organize the selected indicators. The system begins with five main categories (see 4.1), works down to more specific sub-categories, grouping variations together. We used COSA’s master list (https://thecosa.org/master-list/) as a reference in our classification, although we made several modifications that were driven by the coffee-specific data.

   For example, below we have various indicators relating to credit. While these are separate indicators, we grouped them together using the hierarchical indicator classification system. All codes that begin with 4 are economic indicators, while those that begin with 4.5 refer to credit. If the code begins with 4.5.1 the indicator relates to having unqualified access to credit; if it begins with 4.5.2 the indicator relates to obtaining credit; and so on.

4.5.1.1 Access to credit
4.5.1.2 Access to credit from cooperative
4.5.1.3 Access to credit from a bank
4.5.1.4 Had access to credit
4.5.1.5 Obtain credit from cooperative

5 The purpose and source of the indicator. Data is collected by different actors for varying purposes. Therefore, for each indicator in the platform we included the type of date source (baseline, impact evaluation, academic research, etc.). We recorded the name of the source report or dataset and, where possible, a reference, the name of the organisation/author of the source and their type (NGO, academic, farmer organisation etc.), along with a short description. If an organization wished to contribute data or information while remaining anonymous, we ensured that these details are not shared.

6 Location, scope, and methods. For each indicator, we included the country where the data was collected and, where possible or applicable, the region, department, municipality, altitude, and any other location information. We also defined the scope of the indicator as either being nationally representative or not. Moreover, we recorded the data collection approach/method (household survey, member survey, census, etc.) and the year or years for which an indicator is referring to. The oldest data points are from 2010 and the latest from 2020.

7 The sample size and units of measurement. In most cases, we did not include indicators with a sample size less than 15 data points. As for the unit of measurement, we recorded the values in the unit specified in the source. When an indicator has values with different units (e.g., units for weight could include kilograms, quintals, pounds), the platform allows to view them either in their original units or convert and view them in the same unit.