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Smallholder Cooperatives, Climate Change and a Cup of Coffee

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Abstract

This paper explores the ways that climate change is impacting coffee production in Guatemala, the strategies that smallholder coffee producers are using to adapt and specifically the role that smallholder coffee cooperatives can play in supporting or hindering that adaptation. Field research for the paper was conducted in Concepcion Huista, Huehuetenango, in collaboration with a coffee association, Coordinator of Organizations for the Development of Concepcion Huista (CODECH). I discuss the ways that climate change is impacting coffee production in Guatemala, and the significant role that CODECH and smallholder coffee cooperatives can play in supporting climate change adaptation and more broadly in supporting farmers' livelihoods.

The data for my thesis was collected as part of a larger group project that examined the impacts of climate change on smallholder coffee farmers in Guatemala, Peru and Colombia, the approaches that coffee producers and the organizations that support them are currently attempting to adapt/increase resilience to climate change, and which of those approaches seem to be more effective. The group project was hosted by the Nicholas School of the Environment at Duke University in conjunction with Counter Culture Coffee (CCC)—a coffee roaster based in Durham, NC, that works with and purchases from smallholder coffee producers, particularly in Latin America.

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I. INTRODUCTION

Shifts in precipitations patterns, changes in ocean temperatures, changes in glaciers, and recent climate-related extremes including heat waves, droughts and cyclones, among other widespread changes, indicate that climate change is happening (IPCC “Technical Summary” 2014, 40-44). Although people have faced climate change and adapted to it since our species evolved as archeological history evinces, the climate change predicted for this century is far greater and faster than anything previously known in human history and prehistory (Salick and Byg 2007, 6). An especially vulnerable sector to impacts of climate change is the agricultural sector as crops are sensitive to various aspects of weather and climate, for example (Slingo et al. 2005, 1983-84; Porter and Semenov 2005, 2021-27).

In recent years, coffee producers have been increasingly affected by the threats of climate change. Such threats range from an increase in the number and severity of damaging weather events that ruin harvests to decreases in production, due to reduced availability of water on the ground, to increased damages by pests and diseases (Haggard and Schepp 2012, 4; “International Coffee” 2009, 4-5; Jaramillo et al. 2011). The International Coffee Organization indicates that the coffee industry represents the most widely traded tropical agricultural commodity and employs more than 25 million people in 52 producing countries (“World Coffee Trade”). Thus with climate change and its threats on coffee production, adaptation and adaptation strategies of farming communities have become major concerns, especially adaptation for marginalized communities, as the majority of small coffee farmers are peasant producers farming for subsistence with limited resources other than a small plot of land (Jha et al. 2011, 185; Varangis et al. 2002, 9).

Smallholder coffee producers are particularly vulnerable to all types of shocks, including economic and climate change events that exacerbate many of the already precarious conditions they may face (Eakin et al. “Adaptation” 2014, 125; Varangis et al. 2002, 52). Adaptation to climate change refers to “an adjustment in ecological, social or economic systems in response to observed or expected changes in climatic stimuli and their effects and impacts, in order to alleviate adverse impacts of change or take advantage of new opportunities” (Wreford, Moran and Adger 2010, 59). Given these conditions, my research asks the question, how can climate change adaptation be feasible for smallholder coffee farming’ families?

Specifically, my thesis research focused on the ways that climate change is impacting coffee production in Guatemala, the strategies that smallholder coffee producers are using to adapt and on the role that smallholder coffee cooperatives can play in supporting or hindering that adaptation. Research suggests that cooperatives can be instrumental in the livelihoods of coffee farmers. For example, cooperatives in Nicaragua have provided valuable support during coffee crises, including food aid and emergency loans (Bacon et al. “Are Sustainable” 2008, 267), and in Costa Rica smallholder coffee cooperatives have been instrumental for farmers to obtain better prices (Wollni and Zeller 2007, 246-247). It is important to mention here that smallholder coffee cooperatives/associations can have a number of forms. As research indicates, the form a cooperative takes can depend on a number of factors such as founding philosophy, country, and whether the state was involved during or after the founding process (Rice “Noble Goals” 2001, 53; Mendez, Shapiro and Gilbert 2009, 116).

Generally, however, there are primary level cooperatives or community groups involved in the actual labor, production, and sometimes processing of the coffee, and in some cases, cooperatives/associations band together into secondary level organization to take advantage of

economies of scale, and market the coffee worldwide (Rice “Noble Goals” 2001, 53-57). Secondary level cooperatives often process the coffee to its final pre-roast stage (green beans) which is shipped in units called “containers,” each of which contains 37,500 pounds of coffee. (Rice “Noble Goals” 2001, 53-57).

Through key findings in the research, this paper demonstrates how smallholder cooperatives or associations can play a significant role in supporting climate change adaptation strategies and the important role that they are currently playing in their communities. More broadly, through the analysis of field research and literature on coffee cooperatives, the paper demonstrates how smallholder producers and their organizations can promote coffee production where the social and ecological phenomena are linked together, and in turn support climate change adaptation and coffee farmers’ livelihoods.

II. RESEARCH FOCUS/QUESTION

The primary research question I evaluated through my thesis is:
What strategies are small coffee producers in Guatemala using to adapt to climate change and what is the role that coffee cooperatives can play in supporting or hindering that adaptation?

III. METHODS

I conducted field research in Guatemala for two months, from May to July 2014, in collaboration with another student and a coffee association, Coordinator of Organizations for the Development of Concepcion Huista, CODECH. As Table 1 below illustrates, our research methods included: semi-structured interviews, focus groups, household level surveys, and transect walks. To conduct our transect walks we visited coffee plantations with a small group

of CODECH leaders/members. While walking in the plantations, we discussed agronomic conditions and the perceptions of the leaders/members about the causes of such conditions.

Table 1. Data Collection Table

Methods	No. Total	Description
Interviews with CODECH Leaders	6	Including leaders of base level organizations
Household Level Surveys (CODECH Members and Non-members)	24	14-Members 10-Nonmembers
Focus Groups with CODECH Members	2	One with a group of 10 women, and one with a group of 11 men (all members of one of CODECH's base associations)
Transect Walks	4	With CODECH leaders and a member during one of the walks
Interviews with Key Actors in Support Organizations	12	Organizations included: Nonprofit organizations, coffee associations, trade organizations, and second level cooperative umbrella organizations

Specifically, we conducted six interviews with cooperative leaders, two focus groups, and a total of 24 household surveys: 14 with members of CODECH and 10 with nonmembers. We also conducted a total of 12 interviews with key actors from organizations that work with smallholder producers, such organizations included: coffee associations, nonprofit organizations, secondary-level coffee cooperatives, and trade organizations. Additionally, four transect walks were conducted with CODECH leaders (including CODECH Coordinator, Technical Advisor, Women's Group Coordinator, and Base Association Leaders). During one of the transect walks, the owner of the coffee parcel (member of CODECH) also came with us.

IV. SITE DESCRIPTION

The coffee association that collaborated with us in Guatemala, CODECH, is based in Concepcion Huista, a town about a twenty minute drive from Jacaltenango, a small city, in the department of Huehuetenango (See Map 1 below). Huehuetenango is on the Western side of Guatemala and is the third largest producer of coffee in the country (Bennet and Daniels 2011, 14). The population in Huehuetenango is predominantly indigenous (PNUD Guatemala 2012, 88), and agriculture is the primary economic activity (71% of the department’s “economically active” population works in this sector—coffee is the principal crop) (Bennet and Daniels 2011, 14). Data also indicates limited educational opportunities, reflected in high rates of illiteracy in the department (PNUD Guatemala 2012, 86-89; Bennet and Daniels 2011, 14).

Map 1. Concepción Huista, Huehuetenango, Guatemala.



Counter Culture Coffee (CCC)—a roaster that works with and purchases from smallholder coffee producers particularly in Latin America—put us in touch with the association in Concepcion Huista. Counter Culture Coffee has an extended relationship with CODECH since 2010 and felt the association could offer great support for the project (Meeting with CCC

March 31, 2014). The structure and the size of CODECH were also interesting as it is a second level, medium-size association. CODECH is also located in one of the primary coffee growing regions of Guatemala, as previously stated.

CODECH was formed over a decade ago, and as a second level organization represents more than 600 members and is comprised of five base level coffee producer organizations: ADAT, ADIPY, ADINTHEC, BITENAM, and QUIXABAJ, as well as two organizations that do not produce coffee: Grupo de Genero de Mujeres (Women's Group) and El Consejo Magisterial (Teacher's Group). CODECH participates in Fair Trade and a number of members produce organic coffee (BCS certification) (Cooperative Leader Interview May 13, 2014).

V. RESULTS

Our research results find that climate is changing and is affecting coffee production in Guatemala. The main changes perceived by the majority of interviewees include, variability in rain patterns, intense heavy rains, hotter climate, and intense sunshine. Main findings of effects on coffee production include, heavy rains knocking off the leaves and coffee cherries from the coffee shrubs, and recent attacks by *leaf rust*, with the effects of heavy rains and *leaf rust* resulting in production loss. Our research also indicates that smallholder coffee farmers in the region have highly limited access to information about climate change, risks associated with climate change, let alone adaptation. The impacts of climate change for Guatemala are discussed next.

Researchers have already found that the climate in this region is changing and predict that it will continue to change. In recent years, between 2001 and 2007, Guatemala has been severely affected by storms and droughts (Hagggar and Schepp 2011, 4). One of these events was

Hurricane Stan in 2005, which damaged an agricultural area of 720,000 hectares, and severely affected Western departments (De Lima and Bode 2005, 4-5; Hagggar and Schepp 2011, 4). In fact, the Western area of Guatemala has been increasingly affected by extreme events (Castellanos and Guerra 2009, 17, 45). Also, some authors indicate the annual rainy season is getting shorter and more intense in the country (Bevan 2013).

In addition, a study reveals that in Guatemala annual average temperatures for the period 1961-1990 tended to increase (MARN 2007, 4). Similarly, an analysis of climate change indices over the period of 1961-2003 (including Guatemala in the analysis) reveals a general warming trend in the Central American region, with a larger increase in extremely high temperatures than decrease in extremely cold temperature events (Aguilar et al. 2005, 14). Projections for future climate change for the country include an increase in temperature between 2°C–2.5°C by 2050 (Hagggar and Schepp 2012, 10), and a reduction in rainfall during the months of July through September (Castellanos and Guerra 2009, 14). The literature also indicates a concern for future adverse climate variability such as intense rainfall events and droughts (Castellanos and Guerra 2009, 14, 37; Hagggar and Schepp 2011, 4).

We also found that coffee producers, cooperative leaders, and key actors, whom we interviewed and conducted surveys with, felt that their climate had changed. Changes described by interviewees in the municipalities of Concepcion Huista and Jacaltenango (Q'om, where focus groups were conducted pertains to the Jacaltenango municipality) include: a hotter climate and changes in rainfall patterns and variability. Households and cooperative leaders mentioned a hotter climate and intense sunshine that can easily burn the skin. In fact, approximately 65% of our households interviewed mentioned a hotter climate, and at least three cooperative leaders out of six interviewed described a hotter climate as a change.

Changes in rainfall patterns and variability: six household interviewees mentioned either more or intense rainfall as a change, and changes also included, raining during the non-rainy season or the rainy season starting either sooner or later, as mentioned by four households and three cooperative leaders. Instances of excessive rain were mentioned by half (3) of the cooperative leaders interviewed, and one of the leaders specifically stated that constant rainfall can last for long periods of time such as one or two weeks (Cooperative Leader Interview May 20, 2014). Excessive rain was also mentioned during our focus group with men (Focus Group May 15, 2014).

Changes described by key actors (key actors were located in different cities of Guatemala), also indicated a hotter climate and changes in rainfall patterns and variability. At least three key actors mentioned a warmer climate and four key actors mentioned excessive, intense rainfall as a change. A key actor corroborated information given by the cooperative leader (mentioned above) that constant rainfall can last for long periods of time such as one or two weeks (Key Actor Interview July 2, 2014), and three key actors stated rainfall patterns as a major change for Guatemala (Key Actor Interviews, June 23 and June 30 #1, 2014; July 1, 2014 #2). The impacts of these climate changes on coffee production are discussed below.

Impacts of Climate Change on Coffee Production

Temperature and rainfall conditions interfere in coffee crop phenology and play an important role in defining potential coffee yields (Camargo 2010, 240-241; Gay et al 2006, 274; “International Coffee” 2009, 6-7), indicative of how coffee production is sensitive to climate change. Authors have noted that persistent and heavy rainfall can lead to flower and fruit fall (Hagggar and Schepp 2012, 10; Schroth et al. 2009, 616). Our research also reveals impacts of

rainfall conditions on coffee production. A key actor highlighted that in some areas of Guatemala it is now raining during the flowering periods and the rain knocks off the flowers from coffee shrubs, and as a result less coffee is produced (Key Actor Interview July 2, 2014).

During our focus group with men, farmers described that excessive, constant rain, knocked off leaves of coffee shrubs in 2013, and excessive rain also impacted coffee in 2014, in both years this affected maturation as coffee did not mature (Focus Group May 15, 2014). A cooperative leader indicated that with excessive rain (as is typical nowadays), leaves and coffee cherries fall from the coffee shrubs, and when leaves fall, fruit cannot grow very big and this affects quantity and quality (Cooperative Leader Interview May 21, 2014 #1). The statement of another cooperative leader also describes the impact of excessive rain on both production and quality. In his words:

The rain can greatly affect coffee cherries at the beginning of maturation. The coffee cherries fall with too much rain and you cannot harvest and produce much coffee. Sometimes it rains hard and constantly for one or two weeks and people cannot go and harvest, and coffee cherries fall. Also, if cherries remain in the coffee shrubs for too long that also affects quality. (Cooperative Leader Interview May 20, 2014)

Impacts on the processing aspects of coffee were also revealed. A cooperative leader provided a recent example. As he stated, the heavy rain during the months of November through January, which is the harvesting time at low elevations (approximately 1500m above sea level), affected the drying process and the parchment coffee grew mold (Cooperative Leader Interview, May 15, 2014). A key actor corroborated that rain during harvesting time negatively affects

harvest, and can also affect the quality of coffee as heavy rain certainly complicates drying processes (Key Actor Interview June 30, 2014 #1).

Temperature increases can also favor the proliferation of certain diseases in coffee production, such as *leaf rust*, whose proliferation is facilitated by the persistence of rain and high relative humidity in the environment (“International Coffee” 2009, 9-10, I-2). Our research finds that in Guatemala, *leaf rust* has been a major problem for some coffee parcels in the past few years, especially at lower elevations (Key Actor Interviews, June 5 and 20, 2014), for example around 1000m above sea level, as a cooperative leader described (Cooperative Leader Interview May 9, 2014 #1). The disease has been exacerbated by the climate changes, as key actors (Key Actor Interviews, June 20, 23, and June 30 #2, 2014; July 1, 2014 #3) and cooperatives leaders mentioned (Cooperative Leader Interview May 21, 2014 #1). This has resulted in production losses as key actors (Key Actor Interviews, June 20 and June 25 #2, 2014), and cooperative leaders indicated (Cooperative leader Interviews, May 9, 2014 #1 and #2).

Other research also reports impacts on coffee production as a result of climate change in Guatemala. The high rainfall from Hurricane Stan impacted coffee producers in 2005 as 20% of harvest was lost in the Pacific region of the country, road infrastructure was destroyed, and many coffee mills were damaged (Hagggar and Schepp 2012, 10). Also, a study based on farmers’ perspectives indicates that 27% of farmers lost coffee in 2006 due to excess rainfall and 26% due to lack of rain, as Hagggar and Schepp 2011 report (8). Having discussed the impacts of climate change on coffee production, some adaptation strategies found in our research are discussed next.

Current Adaptation Strategies

Our findings indicate some current adaptation strategies such as maintaining shade tree diversity in coffee plantations, renovation of coffee plantations¹ by a few farmers to combat *leaf rust*, planting trees outside coffee plantations, and various sustainable agricultural practices that can improve the ability of coffee to resist impacts of climate change. However it is important to mention here that with the exception of a few farmers specifically mentioning some of these strategies to cope with a hotter climate, most farmers felt their climate had changed but did not specifically mention these strategies to cope with the climate changes.

In fact out of 22 households that felt the climate in the area had changed, nine responded they had not modified any agricultural practices or activities to cope with those changes. On the other hand, when farmers were asked if they thought their household and/or cooperative could play a role to either aggravate or combat climate change, most farmers responded they could contribute to combating climate change with various sustainable and environmentally friendly practices and some farmers indicated they were already doing so (with their association's support).

Shade Tree Diversity:

Our research found high levels of shade tree diversity in some coffee parcels. The variety included bananas, mangoes, peaches, avocados, *chalum* and *gravilea*, and many others. For example, during one of our transect walks we visited a coffee plantation that included among other trees, four types of fruit trees: peaches, oranges, persimmons, and pacayas. The

¹ Renovation involves either planting new coffee plants in an area already cultivated (recommended where plantations are too old and unproductive), or carefully pruning shrubs with specific techniques (recommended where plantations are still somewhat healthy and productive) (Lopez and Pappa 2013, www.anacafe.org).

cooperative leader pointed out that the parcel was less than four “cuerdas,” approximately .17 hectares and explained the reason behind such diversity of trees (Transect Walk June 6, 2014).

The cooperative leader explained that, the orange tree provides shade for the coffee, food for the family and may even help supplement the family’s income by selling the fruit (Transect Walk June 6, 2014). He also stated that the trees help maintain moisture in the soil, which benefits the coffee shrubs, and can also prevent disease and pest outbreaks by creating a poly-culture on the farm (Transect Walk June 6, 2014).

Renovation of Coffee Plantations:

ADIPY, a base association is providing seedlings to members affected by *leaf rust* so that they can renovate their plantations (Coop Leader Interview May 14, 2014). Two households also mentioned renovating their coffee plantations to combat *leaf rust* (Household Interviews, May 23 #2, 2014, Nonmember and June 2, 2014, Member).

Planting Trees:

Four households mentioned they are planting trees specifically to cope with the hotter climate they mentioned (Household Interviews, May 16, 23 #1, 27 and 28, 2014, 2 Members and 2 Nonmembers).

Sustainable Agricultural Practices:

Sustainable agricultural practices included among others, terraces, “barreras vivas” and “barreras muertas,” and using organic fertilizer and compost to maintain healthier coffee plantations. As a cooperative leader explained, “barreras vivas” are simply bushes and other plants planted and maintained around coffee plantations to help reduce run-off and prevent erosion, and “barreras muertas” serve the same purpose, but can be constructed with rocks and

stubble for example (Transect Walk June 6, 2014). We observed both types of barreras during one of our transect walks.

Adding or maintaining compost/mulch around the coffee plants to help plants cope with heat during the summer was mentioned by three households (Household Interviews, May 23, 2014, #1, Member; May 28, 2014 Nonmember, and June 2, 2014, Member). The role of CODECH and smallholder coffee cooperatives/associations supporting and facilitating climate change adaptation strategies is discussed next.

Role of Smallholder Cooperatives/Associations in Supporting Adaptation

As we found, CODECH and the sub-cooperatives/associations are currently supporting several of the adaptation strategies mentioned above, however there are ways in which CODECH could improve or increase support to some strategies. A discussion of the role of CODECH increasing or improving support to some adaptation strategies is presented in the following paragraphs, as well as the discussion of how smallholder cooperatives/associations can play a role in supporting climate change adaptation in general.

An essential step towards adapting to climate change is to adapt now because climate variability, extremes and change are a present danger, not just in the distant future, as underlined by an Assessment of Impacts and Adaptation to Climate Change (Leary 2007, 4). CODECH and the base associations can support this step by encouraging members to maintain and improve shade tree coffee production practices (agroforestry) as an adaptation strategy. To encourage members to maintain and improve these practices, CODECH can provide specific information about how shade coffee production supports coffee to resist impacts of climate change. For example, CODECH could provide information on the importance of shade trees to help maintain

moisture on the ground, as the cooperative leader indicated (Transect Walk June 6, 2014), but CODECH could also disseminate other pertinent information that leaders may have access to, such as research findings (many are accessible online) providing information on the potential of agroforestry systems to protect coffee plantations from extreme events.

For instance among various other events, Hurricane Mitch in Central America is an event where a survey reveals that, farmers using practices of agroforestry suffered less damage during the hurricane than their neighbor farmers using conventional monoculture practices, because their plots had more topsoil, greater soil moisture and less erosion (Altieri, Koohafkan and Nicholls 2014, 2). Or, there are even more specific findings, for example agroforestry protecting fruit development and production yields (Lin 2006, 147-150), since we found heavy rainfall is affecting fruit development (maturation) and production levels in the region. CODECH could share with members that high levels of shade trees (60-80%) can buffer microclimate variability and protect water availability for the crops, and that this in turn has positive effects on fruit development and production yields (Lin 2006, 147-150).

In addition, to encourage members that do not currently have diversity of trees in their plantations or that are cultivating coffee under the sun,² approximately 20% of members (Cooperative Leader Interview May 13, 2014), CODECH and the base associations can provide information but also assist farmers by providing seedlings/seeds, especially as not all members encouraged to diversify plantations may be able to obtain or have access to seedlings/seeds. Also, to motivate the members that cultivate coffee under the sun to practice shade coffee production, CODECH can provide and emphasize additional information about the many

² Where coffee shrubs are grown in the absence of shade trees and in direct sunlight (0% shade cover) (Jha et al. 2011, 144).

socioeconomic benefits associated with diversified coffee plantations, such as fruit trees providing food and in some instances supplemental income, as the cooperative leader mentioned during our transect walk (Transect Walk, June 6, 2014) and also concurred by other research (Rice “Agricultural” 2008, 213).

CODECH can also support the adaptation strategy of the few farmers currently planting trees outside coffee plantations. One way to support the individual efforts of farmers adapting this way is to provide organizational support to get members and the community to work collectively. In fact, it may just be a case for a need to mobilize and organize a reforestation project in the community, as interviewees, including cooperative leaders and households (both members and nonmembers) recognized the need to plant trees. For example, nine households (five CODECH members and four nonmembers) recommended planting trees to combat climate change, to provide shade for example.

Furthermore, planting trees was also suggested as a strategy to improve access to firewood as firewood is the common fuel for cooking in the area (out of 24 households interviewed only one uses gas for cooking). Yet access to firewood has become more difficult for some farmers. For example, two households mentioned difficulty accessing firewood due to deforestation (Household Interviews, May 13, 2014, Member and May 16, 2014, Nonmember). During both of our focus groups, planting trees was also recommended as a strategy to have more firewood available and to “purify the air,” as participants in the men’s focus group expressed (Focus Groups May 14 and 15, 2014).

Nonetheless, the few farmers that are planting trees outside their coffee plantation mentioned this has facilitated and ensured access to firewood. As one household stated, access to firewood is secured planting trees both, in the coffee plantation, as well as outside the

plantation (Household Interview June 2, 2014, Member). Thus CODECH could support a reforestation project by inviting those members that are currently planting trees to share with members and nonmembers, for example, how planting trees has facilitated and secured access to firewood and helped cope with the hotter climate. CODECH could certainly integrate and provide the organizational support in the community for a reforestation project. After all, CODECH provides a space for farmers to come together, share information and exchange knowledge, as I observed while conducting the research, and through this space, opportunities for collective action can arise. This also portends that smallholder cooperatives/associations can play an important role for climate change adaptation in their communities, because as experts remark, collective organization can enhance the adaptive capacity of a society to the threats posed by climate change and variability (Adger et al. 2004, 35-36).

By providing support to these two strategies of shade coffee production practices and planting trees outside coffee plantations, CODECH also supports adaptation to climate change in a broader sense. First, maintaining and improving shade coffee production practices, presents a comprehensive approach to adapt to climate change because high levels of shade trees reduce vulnerability—the propensity or predisposition to be adversely affected³ (IPCC “Technical Summary” 2014, 39)—to current climate changes (e.g. hotter climate) as well as to future extreme events (e.g. hurricanes, El Niño events), for which as previously stated there is a concern in Guatemala. As a matter of fact, the literature on climate change adaptation emphasizes that adaptation strategies incorporate comprehensive approaches, in that adapting to current climate variability helps prepare for future climate change (“Adaptation to Climate”

³ “Vulnerability encompasses a variety of concepts including sensitivity or susceptibility to harm or lack of capacity to cope and adapt” (IPCC “Technical Summary” 2014, 39).

2013). The role of CODECH here is fundamental, not just to maintain shade tree coffee production practices but moreover to encourage those members who are cultivating coffee under the sun to adapt with agroforestry practices.

Second, as previously stated, firewood is the common fuel for cooking in the area. Farmers indicated firewood is collected from their coffee plantations, specifically from “desombra,” a method of pruning shade trees and removing branches that may be contributing excessive shade. Thus if CODECH supports shade tree coffee production practices and the efforts of the few households already planting trees outside coffee plantations, farmers could be self-reliant for their firewood. This in turn would alleviate pressure on some of the natural forests in the area where research indicates firewood consumption is a direct driver of deforestation (Bennet and Daniels 2011, 17). Protecting natural resources (forests in this case) is essential for climate change adaptation, as degraded states of natural resources not only make the resources but also the people dependent on them highly vulnerable to future damages from climate change (Leary 2007, 12).

CODECH can also support climate change adaptation strategies, such as the shade coffee production strategy for the 20% of members who cultivate coffee under the sun, through what has been called “generic form of adaptation.” As Fankhauser et al. 1999 state, having the ability to adapt requires that there is room to change behavior, thus “to encourage changes in behavior through education on the risks that current behavior and customs may pose under climate change and how behavior can be modified to better prepare for climate change,” refers to the “generic form of adaptation” (74). This suggests that it may be difficult for farmers to change sun coffee production practices to shade tree production because sun coffee production practices may be

guided by custom, and behavior and customs are difficult to change (Fankhauser et al. 1999, 74). However, CODECH can encourage changes through education and training.

For example, as I observed, CODECH and the sub-cooperatives/associations have encouraged and influenced members to change conventional agricultural practices to sustainable and environmental friendly practices by emphasizing the need for such practices and providing the necessary training. Through our household surveys and focus groups, members of CODECH revealed they are thoroughly conscious of the importance of sustainable agricultural practices, and environmentally friendly measures. In fact, more than 50% of members interviewed highlighted the importance of organic agriculture in different ways. As an example, when members were asked what, if any, improvements they would like to make in their agricultural practices, two households responded they would like to use organic fertilizer (Household Interviews, May 13, 2014, #1 and #2, Members).

Other households indicated that base associations, such as BITENAM, are creating awareness of the importance of environmentally friendly practices through trainings (Household Interview May 23, 2014 #1), and some members specifically stated they are implementing some of those practices (Household Interview May 27, 2014, Member). Likewise, members were not only aware of negative effects associated with conventional agricultural practices but mentioned that they were implementing measures to reduce those effects and that they have changed previous agricultural practices.

To provide a specific example, during our focus group with men, participants described how chemicals cause contamination and stated that they no longer use *gramosol* (a chemical); instead they are using organic fertilizers to reduce contamination (Focus Group May 15, 2014). The farmers were in fact elaborating an organic fertilizer, “lombricompost,” with the help of

their base association, as participants showed us (Focus Group May 15, 2014). Clearly farmers had an understanding of the negative effects associated with previous agricultural practices. It is important to mention here that this included all kinds of members, including those that are producing coffee organically as well conventionally, because it shows the awareness across all members. Surely CODECH and the sub-cooperatives/associations have played a role disseminating information, creating awareness and encouraging practices that people are now employing. Thus the “genetic form of adaptation” to encourage shade coffee production practices as an adaptation strategy can be supported by CODECH and the base associations.

Someone may point out a potential bias in our research here in terms of the selection of participants for the household surveys, since CODECH collaborated with us to gather the data, and that in turn could have influenced the data we obtained about the changes from conventional to sustainable and environmentally friendly practices. Nonetheless, as previously stated the information came from both, members producing coffee conventionally as well as members producing coffee organically. Additionally, we included members who belonged to the different associations (that comprise CODECH), and that lived in different towns, such as Santiago Petatan, Q’om, and La Estancia. Moreover, a couple of times we ended up interviewing completely random households due to weather and time constraints that interfered with our plans. Other literature also portrays that cooperatives have encouraged farmers to change behavior, for example, from farmers only producing coffee to farmers caring for the preservation of their natural environment and interested in gender equality (Mendoza et al. 2012, 11).

One can clearly see how cooperatives/associations can be successful in disseminating information and encouraging changes in farming practices. As I observed, smallholder coffee cooperatives/associations offer a space where farmers are likely to spend some time when not in

the fields to talk about farming practices, needs, and listen to experiences of other members. Farmers not only receive information from cooperative leaders but most importantly they learn from each other (personal observation). For example, it was interesting to observe during some training sessions in CODECH, how farmers saw pictures of two or three coffee plantations and then compared them not only to decide which plantations were, for example, in better condition and which were not, but also to discuss what the farmer must or could be doing to keep plantations in such conditions. Through trainings and information, CODECH members cultivating coffee under the sun, can become aware of the risks of that way of producing coffee in the face of climate change.

By providing a space for farmers to share information, CODECH can not only disseminate pertinent information about climate change but also create awareness for the need to adapt. This is particularly important amongst this population because as our research reveals, smallholder coffee farmers in Guatemala have highly limited access to information about climate change and risks associated with it, let alone adaptation (Key Actor Interviews, June 5, 13, and June 30 #2, 2014; July 1, #3 and July 2, 2014). As we found, information and training provided by CODECH and the sub-cooperatives/associations can also have a spillover effect and influence the entire community. This in turn supports farms' resilience to climate change, as well as the ecological resilience of communities.

The concept of resilience refers to “the capacity of environmental (social, economic) systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation” (IPCC “Technical Summary” 2014, 40). When the concept is applied to farms, it emphasizes a farm's dependence on its own resources

instead of external inputs, as elucidated by some authors (Milestad 2003, 37; Borron 2006, 4). Therefore, the role of CODECH in supporting sustainable agricultural practices is contributing to farms' resilience, for example by farmers reducing the use of chemicals as previously noted.

Through a spillover effect, some sustainable practices of coffee production can easily be adopted in the cultivation of other crops, such as maize and beans, and enhance resilience for those cultivation fields as well. For instance, in our focus group with men, farmers stated they no longer use a hoe for the "milpa" (corn field) because they understand how that tool contributes to soil erosion (Focus Group May 15, 2015). This was also pointed out in our focus group with women, as they stated that men are now protecting the soil not using a hoe (Focus Group May 14, 2015).

The spillover effect also influences nonmembers of CODECH as they learn about sustainable and environmentally friendly practices through friends that are members of the Coordinator of Organizations for the Development of Concepcion Huista. As a cooperative leader stated, CODECH members learn coffee management practices that they share with friends that are nonmembers. For example, as the leader indicated, members have learned coffee processing techniques and coffee managing practices (including coffee quality control, pruning, weeding, and fertilization practices) that no one knew before and now even nonmembers have adopted (Cooperative Leader Interview May 21, 2014 #2).

Similarly, through one of our key actor interviews (interviewee is also the leader of a cooperative) we learned that cooperative La Voz in San Juan La Laguna, imparts training specifically to nonmembers to cultivate coffee using sustainable agricultural practices (Key Actor Interview June 20, 2013). As we observed, the cooperatives' calendar of activities delineates dates for training of both members and nonmembers. When the key actor was asked if

nonmembers make any kind of financial contribution to the cooperative for these trainings, he replied: “We only create awareness for them [nonmembers] to work the soils without contaminating, to plant more trees. We create awareness, not for them to contribute to the cooperative, but to the natural environment.” (Key Actor Interview June 20, 2014).

This is a powerful statement that clearly depicts the interest of the cooperative in helping the entire community to be environmentally sustainable, and as a result, the coffee fields of nonmembers will be more resilient to climate change as well. It is also powerful because the role that associations/cooperatives are playing here is going beyond members and reaching out to the community. Certainly, community involvement is essential for adaptation to climate change. As some authors emphasize, although adaptation to climate change for agriculture starts at the farm level, the community as a whole must be involved for adaptation to be effective (Roge et al. 2014, 787). All of these previous examples illustrate that, coffee growers who are members of cooperatives/associations can cultivate coffee through sustainable agricultural practices, but the community in general can also be influenced to adopt a sustainable way of living and thus enhance ecological resilience to climate change.

Along the same lines, smallholder cooperatives/associations organize their members to participate in environmentally friendly projects which can reduce the vulnerability of ecosystems and thus reduce the vulnerability of the entire community to climate change—as indicated before, degraded natural resources make the people dependent on them more vulnerable to climate change. As an example, one of CODECH’s base associations organized a trash collection activity from which reusable/recyclable materials were used to help build a little school, and also as part of the project, a dump to collect garbage was built (Household Interview May 27, 2014, Member). Obviously, the school is for the community’s use, but these types of

activities can also reduce non-climatic stressors that increase vulnerability of ecosystem to climate related risks. For example, land use and pollution can be non-climatic change related stressors that can shape the vulnerability of an ecosystem and weaken its resilience (Leary 2007, 9; IPCC “Emergent Risks” 2014, 1053, 1085). The key here is to reduce vulnerability of systems, and through these types of activities, smallholder cooperative/associations reduce non-climatic stressors to a natural system, increase resilience, and along the way benefit their entire community.

A reader may point out here that the production of coffee also brings negative environmental impacts, especially during the processing of the coffee cherries which can result in water pollution and methane emissions (“Coffee, Conservation”). Smallholder coffee producers and their organizations, therefore, may be contributing to climate change itself and thus negatively affecting their communities’ resilience to adapt to climate changes rather than enhancing adaptation. However, it is precisely here that smallholder coffee cooperatives/associations can make a difference to support producers to increase resilience to climate change because cooperatives/associations provide a space to learn about climate change in general, and also a space for farmers to learn how their agricultural practices can either negatively or positively affect adaptation, as previously suggested.

With the assistance of cooperatives, the negative environmental effects can be minimal or avoided. As a cooperative leader in CODECH pointed out, their members have learned and continue to learn various coffee processing techniques to take care of the soil and not to use chemicals, including the fact that farmers now elaborate their own compost using the coffee pulp when previously they did not know the pulp could be of any use (Cooperative Leader Interview May 21, 2014 #2). In addition, a recent proliferation of potential uses of coffee residues

illustrates that these residues can help promote environmental sustainability (Rathinavelu and Graziosi 2005, 1-3), including using residues as a source for renewable energy (Rodriguez-Valencia and Zambrano-Franco 2014, 1-5). Farmers can certainly learn about the many uses of coffee residues from their cooperatives/associations as the cooperative leader indicated above, and receive necessary trainings.

Moreover, the cultivation of coffee through an agroforestry system offers a great potential to mitigate climate change, to reduce stress on natural systems, and provides several ecosystem services (Schmitt-Harsh et al. 2012, 154-155; Jose 2009, 1-3; Jha et al. 2011, 144), which certainly enhance resilience to climate change (Altieri, Koohafkan and Nicholls 2014, 3; Jha et al. 2011, 171, 178). The various ecosystem and environmental services include carbon sequestration,⁴ soil fertility, improved water quality, and support for biodiversity conservation (Jose 2009, 1-3).

The role of cooperatives/associations in supporting the strategy of agroforestry systems to adapt to climate change was previously mentioned but it is critical to add here that if smallholder farmers and their organizations maintain and improve the cultivation of coffee through agroforestry systems, this would bring several ecological benefits that can improve the health of ecosystems and thus contribute to climate change resilience not just at a local level, but also at a global level (see Table 2 below), as many of the services are enjoyed by society on a larger scale (Jose 2009, 2).

⁴ Carbon sequestration involves the removal and storage of carbon from the atmosphere. One type of sequestration is the storage of carbon in trees and plants in the form of biomass ("US Environmental Protection" 2012, 2).

Table 2. Spatial Scales of Various Ecosystems Services Provided by Agroforestry Systems

Ecosystem Services	Spatial Scale		
	Farm/Local	Landscape/Regional	Global
Net Primary Production			
Pest Control			
Pollination/Seed Dispersal			
Soil Enrichment			
Soil Stabilization/Erosion Control			
Clean Water			
Flood Mitigation			
Clean Air			
Carbon Sequestration			
Biodiversity			
Aesthetics/Cultural			

Source: adapted from Shibu Jose, 2009, p. 2

The literature on adaptation to climate change underlines the importance of developing adaptation options for agriculture that do not exacerbate climate and other environmental changes (Slingo et al. 2005, 1986; Altieri, Koohafkan, and Nicholls 2014, 2). Through agroforestry systems, farmers and their cooperatives/associations can maintain, enhance and undertake this kind of adaptation for coffee production as discussed above. In fact, some authors have highlighted that maintaining shade trees in the coffee system is an easy and suitable risk aversion measure that can be considered as an adaptation strategy, not just by its effectiveness but also by “virtue of its cost” (Lin 2006, 48-49). Indeed, resources or access to resources can play an important role in adaptation to climate change, as our research reveals.

Our research finds that lack of resources, specifically financial resources is a major challenge for smallholder coffee farmers in Guatemala, and presents a challenge for adaptation to climate change. As we found, access to credit is difficult to smallholder farmers because among other reasons, smallholder farmers do not have the proof of income or collateral that banks require, not to mention the fact that interest rates from banks are extremely high (Key Actor Interview July 2, 2014; Cooperative Leader Interview May 21, 2014 #2). Some farmers asserted

this information stating they would not go to a bank because of the high interest rates (Household Interview May 8, 2014 #1, Member). This of course has implications on the management of the coffee plantations and in a farmer's capacity to adapt, as the capacity of individuals to adapt to climate change is a function of their access to resources (Adger et al. 2004, 35). CODECH and the sub-cooperatives/associations ameliorate the situation in various ways, as discussed in the following paragraphs, and support adaptation.

The data collected from our key actors and cooperative leaders reveals that coffee plantations in Guatemala are too old (for example older than 25 years), and the fact that many are not well-managed makes them vulnerable and more susceptible to pests and climate change events, including *leaf rust* (Key Actor Interviews, June 20, and 23, 2014; June 30, 2014 #2, and July 1, 2014 #3). Yet these are also the implications of lack of resources because although renovation is suggested as a strategy to make coffee plants less vulnerable (Key Actor Interview June 30, 2014 #1), complete renovation of a plantation means that a farmer would have to wait at least three years before coffee is produced again, as a key actor highlighted (Key Actor Interview June 23, 2014). In short, the lack of resources presents a challenge for adaptation to climate change, especially for households where coffee is the only or the main source of income, as the words of a key actor encapsulate:

If smallholder farmers are having a difficult time with their coffee, what do they do? If coffee is the main source of income; on that depends the education for the child, the food for the week, for the month. In other words, what happens when there is a coffee crisis, when prices are low? And if it isn't about prices, it's about *leaf rust*. (Key Actor Interview June 5, 2014)

CODECH and the base associations/cooperatives are supporting members to ameliorate the situation, for instance as previously noted, a base association is providing seedlings to members affected by *leaf rust* to renovate their plantations (Cooperative Leader Interview May 20, 2014).

As a matter of fact, a household's access to resources is an important determinant of its vulnerability to climate change (Leary 2007, 8-9). Here, CODECH and the base associations can support members to reduce vulnerability to climate change by facilitating access to credit. As we learned from one of the base associations, ADINTHEC, members rely on the association for credit services every year (Key Actor Interview May 21, 2014 #1). As another cooperative leader pointed out, access to credit is also facilitated through the cooperatives/associations in the sense that it is a simpler process with lower interest rates compared to bank loans (Cooperative Leader Interview May 21, 2014 #2).

There is also a special credit service that CODECH provides to selected members, as compensation for keeping well-managed coffee plantations and for being in transition from conventional to organic coffee production (Cooperative Leader Interview May 21, 2014 #2). The literature indicates that other smallholder cooperatives/associations also provide support by facilitating credit services. For example, a cooperative in Oaxaca, Mexico, ensures that credit services are available to its members (Aranda and Morales 2002, 4-5). By extension cooperatives in general could support farmers to adapt to climate change by facilitating access to resources.

CODECH is also supporting members to maintain healthier plantations, which can reduce vulnerability of plants to impacts of climate change. For example, two key actors provided specific comparisons where well-managed, healthy plantations had been less affected by *leaf rust*, compared to those that were not well-managed, including the fact that *leaf rust* could be

better “controlled” in healthier, younger plants (Key Actor Interviews, June 5 and 23, 2014). To maintain healthy coffee plantations, CODECH is providing trainings on how to elaborate “bokashi,” a type of compost that fertilizes the soil and provides nutrients such as potassium (Cooperative Leader Video May 23, 2014).

As I observed, “bokashi” is elaborated with local resources that most farmers can easily attain, ameliorating the situation of lack of resources. The ingredients to elaborate “bokashi” include banana leaves, weeds, coffee pulp, manure, and ash, resources that most coffee farmers can obtain. Yet, if all the ingredients or most of the ingredients had to be purchased, or were only found in distant areas (urban areas for example), most farmers could certainly not elaborate and use the compost. As a key actor mentioned, smallholder producers do not necessarily have the resources, or access to transportation services to go from one place to another (Key Actor Interview July 2, 2014). Thus one can also point out that because smallholder cooperatives/associations are knowledgeable of local circumstances, they can also provide support for effective adaptation strategies.

CODECH leaders for example, are aware of the limited resources available to farmers and recognize that that can impose limitations on the agricultural practices farmers can implement, as a key actors reflected, sometimes farmers receive trainings on how to improve coffee management and production but they do not have the resources to implement what they learn (Cooperative Leader Interview May 20, 2014). Smallholder cooperatives/associations are definitely aware of local circumstances and can support adaptation strategies taking into account local contexts. This sheds light on the fact that smallholder cooperatives/associations can be a vehicle to transmit pertinent local information to external organizations working on climate change adaptation, for example.

In fact, smallholder cooperatives/associations can work with external organizations and provide input, in terms of suggesting what adaptation strategies could be more apt and feasible for local contexts. Context is significant when considering adaptation strategies because as a key actor reflected, what is the point of teaching a farmer how to use coffee pulp as a source for fuel, when they do not have the resources to buy the stove (Key Actor Interview July 2, 2014). The examples above provide a snapshot of how climate change events can affect smallholder producers and how that in turn can be exacerbated by lack of resources, mainly financial resources. But, is there any governmental support? Someone might ask.

Our findings reveal that in general there is not much governmental support for smallholder farmers, nor for adaptation to climate change. Out of 24 households, only two reported they had received support from a governmental agency, and the support was 1-2 bags of fertilizer one time (Household Interviews, June 2, 2014 #2, #5, Nonmembers). In addition, key actors often mentioned that although there may be some interest in supporting adaptation to climate change from the government, there is not much in practice (Key Actor Interviews, June 5, 13, and 20, 2014). Our interviews suggest that the government has announced some programs to help smallholder producers, for example with *leaf rust*, but as of now, smallholder producers have not received any information or support (Key Actor Interview June 13, 2014). In fact, the state introduced a bill on climate change in 2009, which lists adaptation as one of the priorities yet implementation is still to be seen (Key Actor Interviews, June 5 and 20, 2014). As one key actor mentioned if there are other pressing needs, such as building a road, those projects may well take precedence over adaptation to climate change (Key Actor Interview July 2, 2014). Other literature reports similar information (Castellanos and Guerra 2009, 46; Bevan 2013).

Nonetheless, smallholder cooperatives/associations also provide complimentary projects that go well beyond producing coffee, projects that enhance socio-economic conditions, and enhance adaptation to climate change. CODECH has enabled conditions for farmers to have garden cultivations with a variety of vegetables. As a household revealed, a base association also gave away chickens specifically to women coffee producers (Household Interview June 2, 2014 #3). These projects support farmers' livelihoods. In fact, when asked if access to food had changed in the past 10 years, two households responded that access to food has changed because now they have the additional garden vegetables (Household Interviews, May 6 and 13, 2014, Members). The literature on climate change adaptation has in fact recommended some strategies and projects that CODECH and other smallholder cooperatives/associations are already supporting. For example, entry into horticulture has been recommended as an adaptation strategy ("Adaptation to Climate" 2013).

Other research on smallholder coffee cooperatives in Central America and Mexico also finds that farmers and their organizations seek diversified livelihood strategies including, among others, strengthening local food security, developing agro-ecotourism, handicrafts, and community forestry (Bacon, Mendez and Fox 2008, 355). Cooperatives/associations also support farmers' livelihoods through discounted stores, bakeries and transportation services at discounted rates (Aranda and Morales 2002, 19-20). Supporting diversified livelihood strategies also represents a crucial role that smallholder cooperatives/associations are playing to support climate change adaptation, as livelihoods dependent on rain-fed agriculture are "directly climate sensitive" to climatic changes (IPCC "Livelihoods and Poverty" 2014, 798). As previously mentioned most smallholder coffee farmers are farming for subsistence. In our research area, farmers cultivate maize and beans for subsistence, and their cultivations are rain-fed

dependent—only one household out of the 24 indicated they have some kind of irrigation system (Household Interview May 16, 2014, Nonmember). Hence, the role of CODECH and smallholder cooperatives in other areas supporting farmers' livelihoods is essential for their communities but also for climate change adaptation.

Another way that CODECH supports adaptation to climate change through complimentary projects is with education projects. As we observed, CODECH women members are learning to read and write. Here, one may think that education does not specifically relate to a climate change adaptation strategy, yet it represents a social condition that, as reflected in our research, can affect adaptation. Key actors indicated that one of the major challenges working with smallholder coffee producers, in Guatemala, is illiteracy (Key Actor Interviews, June 1 2014, #2 and #3, and July 2, 2014). One key actor specifically mentioned you cannot just give out pamphlets with information about climate change and adaptation strategies, for example, because many farmers would not be able to read them (Key Actor Interview July 2, 2014).

The recent Intergovernmental Panel on Climate Change also highlights that lack of education can be a constraint to adaptation because it contributes to vulnerability (IPCC “Adaptation Needs” 2014, 847). To provide one example, in Bangladesh, education about disaster responses was greatly assisted by rising literacy rates, especially among women (IPCC “Adaptation Needs” 2014, 847-848). Besides CODECH, other smallholder cooperative/associations in Guatemala are propitiously supporting the education of their members as a key actor indicated (Key Actor Interview June 5, 2014). Similarly, smallholder cooperatives in other areas are supporting education projects. Simpson and Rapone 2000 find that a smallholder cooperative in Mexico provides support for students to study agronomy, accounting and teaching skills (51-52). Here, smallholder coffee cooperatives/associations are

providing a tremendous contribution to their communities, as literacy can certainly have an impact in adaptation strategies and in general on adaptation to climate change.

The role that smallholder cooperatives/associations are performing through the different projects and sustainable and environmentally friendly practices is significant for their communities to adapt to climate change. Research underlines that while adaptation to climate change can take different forms, increasing resilience of both social and ecological systems is a “major type of adaptation” that includes both, actions to conserve resources as well as specific measures that enable populations to recover from loss (Wreford, Moran and Adger 2010, 60).

Through all these projects and services, one can also argue that cooperatives/associations are lessening conditions that marginalize the coffee communities in the first place, as the examples of lack of education and access to resources above suggest, and in this way also supporting adaptation to climate change because reducing underlying causes of “social vulnerability” is a necessary step to develop sustainable responses to extreme events and climate change (Kelly and Adger 2000, 348). “Social vulnerability” refers to “the capacity of individuals and social groupings to respond to (that is, to cope with, recover from or adapt to) any external stress placed on their livelihoods and well-being, focusing on socioeconomic and institutional constraints that limit the ability to respond effectively” (Kelly and Adger 2000, 347-48).

In fact, it is impressive to see how proactive cooperatives/associations are supporting sustainable producer livelihoods and lives in their communities, despite the fact that lack of resources can also present a challenge for them. Not only leaders of CODECH recognized that the lack of resources is a challenge for CODECH (Cooperative Leader Interviews, May 9 #1 and May 21 #2, 2014) but also two key actors interviewed, who are cooperative leaders, recognized this is a challenge for cooperatives (Key Actor Interviews, June 5 and 20, 2014). Still, as one of

the key actors—who is also a cooperative leader—stated, smallholder cooperatives/associations provide a number of services to members even with the limited resources they have (Key Actor Interview June 5, 2014). To take a case in point, our research revealed that one of the base associations provides transportation when members have medical emergencies and may need to get to a clinic (Household Interview May 27, 2014 #2). Many of these projects provide direct assistance to the entire community, such as the discounted stores and transportation services previously noted.

Most importantly, smallholders and their organizations are also taking other specific actions that support agency of their local communities and reduce institutional and socioeconomic constraints, which can affect “social vulnerability” to climate change as stated above. For example, smallholder cooperatives/association in Latin America formed “La Red Latinoamericana de Comercio Justo” in which smallholder producers and their organizations are co-owners of Fair Trade International (Key Actor Interview June 5, 2014). As a key actor remarked, exporting countries from the South are usually subject to norms and certifications coming from the North, while a few or no norms come from South to North. However as co-owners of Fair Trade International, smallholder producers and their organizations are opening doors and presenting a model to the world, stated the key actor (Key Actor Interview June 5, 2014).

Additionally, smallholder organizations are also supporting the involvement of farmers in coffee processing and marketing chains. For example, a few cooperatives in Nicaragua launched a line of all-female produced coffee (Bacon, Mendez and Fox 2008, 355), and just recently, a cooperative in Peru opened up their first coffee shop selling specialty coffee domestically (“Cafetaleros de Cajamarca” 2014). Another cooperative in Mexico produces its own vacuum-

packed canned coffee (Bacon, Mendez and Fox 2008, 355). Also, to reduce dependence on foreign certification and adapt certification procedures to local realities, cooperatives in Mexico opted for building their own certification capacity (Mutersbaugh 2002, 1170-1171). This demonstrates that smallholder cooperatives/associations are fully aware of local needs encompassing both social and ecological aspects of their communities, tackling underlying causes of “social vulnerability,” and enhancing social and ecological resilience to climate change.

A skeptical reader may point out here that farmers may not always trust cooperatives/associations, as some organizations may have internal issues that could then constrain not only farmers’ perspectives on such organizations but also adaptation strategies to climate change if cooperatives are to play a role. While it is true, there may be some cases where farmers have negative perceptions of farmer organizations (Eakin, Tucker and Castellanos 2006, 167; Taylor 2002, 11), the literature seems to indicate that those cases are generally in situations where organizations were not founded by farmers or the process was not instituted with the motivation and mobilization of farmers but rather by the state (Mendez, Shapiro and Gilbert 2009, 116). On the other hand, cooperatives/associations founded at the grassroots levels tend to have a stronger sense of shared organization where farmers consider cooperatives essential for their socioeconomic development and for the wellbeing of their communities (Mendez 2008, 218-219; Arce 2009, 1038).

Along the same lines, research demonstrates that smallholder cooperatives/associations created by farmers’ grassroots mobilizations are able to overcome challenges and maintain their organization as they truly value their collectivity (Simpson and Rapone 2000, 50; Mendez 2008, 219), whereas those created by the state often collapse (Bacon et al. “Are Sustainable” 2008,

262). In addition, as a key actor mentioned, farmers do not perceive cooperatives/associations as just a place that can export coffee or that can find better prices, instead these organizations are considered an integral part of their livelihoods, especially as many services (provided by the cooperatives/associations) are scarcely or generally not provided by the government (Key Actor Interview June 5, 2014).

Above all, cooperatives/associations have learned from their internal challenges and are working to improve their collective action through education efforts, as we learned from two of our key actors who are also cooperative leaders (Key Actor Interviews, June 5 and 20, 2014). These two key actors reflected on the importance of training and educating future cooperative leaders, because often times, lack of education and knowledge pose constraints for leaders. One key actor stated that their cooperative has had some difficult challenges and hard times. However, with hard work and great effort, they have managed to survive, and are not only now employing better administrative skills, they are also planning to train young people to continue the management and administration of the cooperative as they are doing now (Key Actor Interview June 20, 2014).

The other key actor mentioned, their cooperative has collaborated with a local university and is financing the education of 25 students to gain smallholder cooperative/association management skills (Key Actor Interview June 5, 2014). Other research concurs cooperatives learn from internal challenges and undertake ways to improve management and administration (Mendoza et al. 2012, 13). This not only reflects that cooperatives/associations are instrumental in coffee farmers' livelihoods but also substantiates the point that such organizations are building efforts to deal with deeper issues of marginalization in the first place, which as previously indicated, can have serious implications for adaptation to climate change. Although

cooperatives/smallholder organizations may face internal challenges, local organizations present opportunities for farmers as a way not just to develop opportunities for better production, but can also play a significant role in adaptation to climate change, as found in our research, and clearly acknowledged by other authors (Eakin, Castellanos and Haggard; Schroth et al. 2009, 622).

Furthermore, through cooperatives/associations there is opportunity to share information between producers as previously indicated, but even between cooperatives as a key actor stated (Key Actor Interview June 5, 2014). This represents a practical way for farmers to have their own network of knowledge and to learn best practices. This also includes opportunities to learn and share information about climate change and adaptation strategies. Involving the people at risk of climate change is vital for adaptation strategies to be effective. As a number of case studies clearly indicate, involving people at risk and the intended beneficiaries of adaptation strategies can increase effectiveness of adaptation to climate change, because this offers opportunities to draw on local knowledge and expertise to identify appropriate strategies, and also to have ownership for proposed options (Leary 2007, 12-13). For example, in an Argentina-Mexico study, at-risk farmers and water managers collaborated together and the result was not only guidance on risk perceptions and information needs, but also this led to the development of practical options for water and agricultural practices and policy (Leary 2007, 12).

Having a network of knowledge to share and exchange information between farmers and cooperatives represents an important way for smallholder farmers to actually learn and implement adaptation strategies. This is particularly important for smallholder producers in Guatemala because a number of farmers are illiterate or semi-literate (Key Actor Interviews, July 1 #2 and #3 and July 2, 2014) and have little other access to information about climate change, as previously indicated. Further, when information is available farmers may not necessarily have

access to it. For example, the National Coordinator for the Reduction of Disasters in Guatemala (CONRED, acronym in Spanish), provides weather forecasts and alerts however smallholder producers do not have the resources (e. g. smart phones) to receive this type of information/alerts (Key Actor Interviews, July 1 #3, and July 2, 2014).

Even if cooperatives/associations exchange information that may not necessarily be about climate change or specific to adaptation strategies, some practices and information may end up contributing to adaptation. As a matter of fact, recent research in a society in “adaptation transition” concludes that a well-adapting society includes many adaptations that are the byproducts of activities not necessarily related to climate change (Tompkins et al. 2014, 633). Moreover, learning and sharing information between cooperatives provides opportunity to innovate on adaptation strategies as necessary for each context.

Another essential role that smallholder organizations can certainly play is reaching out to external organizations, while providing a voice for local needs. Institutional and political support seems to be out of reach for smallholder coffee producers in Guatemala, and the best way to seek assistance and support is to be collectively organized, as indicated during most of our key actor interviews (Key Actor Interviews June 13 and June 25 #2, 2014; July 1, 2014 #2). In fact, out of all the key actors representing organizations that work with smallholder coffee farmers, only one key actor stated his organization works with individual smallholder producers (Key Actor Interview June 30, 2014 #1), the rest of the organizations only work with cooperatives/associations. Interestingly, when a key actor was asked his opinion on what strategies could be more effective for smallholder producers to be resilient and to be able to adapt to climate change, he responded that an important strategy is to be collectively organized (Key Actor Interview June 30, 2014 #1). As the key actor emphasized, this not only facilitates

access to technical assistance, for example, but also the measures to adapt to climate change can be more effective when implemented in groups (Key Actor Interview June 30, 2014 #1).

In the case of *leaf rust* for example, as the key actor illustrated, an individual smallholder coffee producer may end up spending money on different products, without effective results, because the farmer may not have access to pertinent information or assistance needed to control the disease. On the other hand, as members of cooperatives/associations, farmers have facilitated access to information and tools necessary to implement measures (including necessary pumps to apply fungicides), to effectively combat the disease both, individually and collectively (Key Actor Interview June 30, 2014 #1). In other words, key actors stressed that if each coffee producer acts independently, it will be much more difficult for farmers to adapt and to face climate change (Key Actor Interviews June 30, 2014 #1; July 1, 2014 #1 and #2). Certainly cooperatives/associations can be the vehicle for smallholder farmers to reach out to external organizations but also, as the key actor pointed out, for smallholder producers to face climate change collectively rather than individually.

Cooperatives/associations can also supplement the meager support for climate change adaptation provided by external organizations, and voice out the way they would like to see climate change adaptation to occur in their communities. As previously stated there is not much governmental support and the support that may exist is not necessarily effective. A key actor described a clear example. The government distributed an agrochemical that was supposed to help combat *leaf rust*, however no instructions were given on how to use the agrochemical, and there was also no follow up support/information (Key Actor Interview June 30, 2014 #1). Also, as key actors accentuated, some governmental programs place a technical advisor to provide support to smallholder coffee farmers. However, there is one technical advisor for a large

number of smallholders in one region and that makes it difficult to reach all farmers (Cooperative Leader Interviews June 13, and June 30 #1, 2014).

This also implies that when farmers are visited by the advisor, it is only for a few hours, and as a result advisors are not able to provide much assistance, let alone information about climate change adaptation (Key Actor Interviews, June, 2, 13, and June 30 #1, 2014; July 2, 2014). As these examples illustrate, this type of support is ineffective. In terms of smaller projects with private organizations, key actors mentioned that usually you never hear about actual implementation or end results (Key Actor Interviews, June 20 and 30, 2014 #1 and #2). Smallholder cooperatives/associations here can take agency and provide a voice for local needs (especially to those organizations that may be working in adaptation projects). This way, smallholder producers can receive assistance and implement effective adaptation measures.

Another aspect of smallholder organizations representing a voice for their communities is illustrated by Coordinadora Guatemalteca. As a key actor explained, Coordinadora Guatemalteca is comprised of 19 smallholder organizations and represents “one voice” that can reach out to other institutions, such as the government or international organizations, to seek cooperation for projects on adaptation to climate change, or for other activities. Indeed, Coordinadora Guatemalteca is currently negotiating with external organizations in Europe seeking collaboration for a project (Key Actor Interview June 5, 2014). As the key actor recognized, the voice of 19 smallholder cooperatives represent a stronger voice than just one cooperative/association (Key Actor Interview June 5, 2014).

A number of examples illustrate that smallholder cooperatives can be successful in collaborating with external organization to support climate change adaptation strategies and projects. For example, Mas Café, a cooperative in Mexico carried out a climate change risk and

opportunity analysis project, and will also be participating in a project to maintain and expand forest cover in the Chiapas area (New Digital, adaptnow.org.uk). In addition, a coffee cooperative in Peru is collaborating with another organization to implement a water conservation adaptation strategy (New Digital, adaptnow.org.uk).

In our research we also received information about a project, “Modulo Clima” or “Climate Module” from key actors, some of whom were authors of the project. The project is being implemented precisely in collaboration with a smallholder coffee cooperative in Guatemala (Key Actor Interview July 2, 2014). Among other pertinent practices, the program requires keeping track of climate change variability (e.g. temperature and precipitation), and includes adaptation measures such as harvesting water, and cultivation of crop varieties resistant to droughts, as well as measures to be prepared in case of climatic extreme events both on the farm and in the community (Amador, Monterroso, Lopez-Rain Forest Alliance, 1-28). This example demonstrates that cooperatives/associations can and are playing an essential role to support adaptation to climate change, and also speaks of the support that cooperatives/associations can provide to implement adaptation projects, as the cooperative collaborated with the project to train farmers so that they can implement the practices delineated in the program (Key Actor Interviews, June 30 #2, 2014 and July 2, 2014).

In fact, smallholder cooperatives/associations can close a gap between available programs and their systematic implementation, as is the situation in some cases. For example in Chiapas, Mexico, government funds are available to support reforestation projects. However, there is a need for community-based organizations to access the funds and to support the implementation of such projects (Schroth et al. 2009, 621-622), a role that

cooperatives/associations can certainly undertake to support climate change adaptation, as some of the examples in this paper illustrate.

Last, from the observations and findings for this paper, one can also pinpoint examples in which smallholder cooperatives/associations can facilitate and support climate change adaptation. For instance one can see how CODECH can participate and support anticipatory adaptation. Through one of our key actor interviews, we heard some pieces of information about a project for coffee and adaptation to climate change under the guidance of the International Center for Tropical Agriculture or CIAT, acronym in Spanish. After looking up more information about the project, one can see that it includes an analysis of the agro-climatic suitability of different crops that farmers are currently cultivating (such as avocados, oranges, and beans and corn) in coffee-growing regions of Guatemala (CIAT 2012, 24). The results indicate, for example, that banana is not affected by the increments in temperature and rainfall reduction predicted for the country. On the other hand, beans are highly affected by droughts and floods, for example, and the areas suitable for bean cultivation will be greatly reduced by the year 2050 (CIAT 2012, 27-28).

However, our research indicates that farmers as of now do not have any of this information. Nonetheless if CODECH is given or obtains this information, leaders could disseminate it to their members, discuss which crops would be more suitable for the region in the face of climate change, and identify ways that could improve the capacity to adapt this as a strategy, and indeed plan anticipatory adaptation. This suggestion is also based on the fact that many members of CODECH already have diversity of trees in their plantations, while others cultivate monoculture coffee. Accordingly, leaders and members of CODECH can easily discuss how this could be feasible or not for each member, etcetera.

In addition, borrowing from the “Modulo Clima” project, one can point out another small but essential manner in which smallholder cooperatives/associations can contribute to support climate change adaptation: gathering essential information. Cooperatives and their members can track information of changes in climate variability as farmers experience it, and in this way help record local changes. This information is vital for adaptation strategies. It is often indicated that the effects of climate change will be diverse and the impacts at smaller scales (intraregional and within countries) may be severe but hard to predict (Keane et al. 2009, 2), especially in mountainous environments where coffee is often grown, which can involve differences in elevations, temperatures and precipitations, that are rarely captured by regional weather station data (Eakin et al. “Adaptation” 2014, 130). Most of the information about climate change is from scientific and media coverage, yet local observations are equally important as they present local and tangible observations (Salick and Byg 2007, 18), that can certainly be considered for possible adaptation strategies.

VI. CONCLUSION

The Intergovernmental Panel on Climate Change observes that, adaptation planning can be complex, diverse and context dependent, that there is no single approach and that adaptation actions in practice are combinations of top-down and bottom-up approaches (IPCC “Adaptation Planning” 2014, 871-872). Smallholder cooperatives/associations can certainly be a connecting point and intermediary for both approaches yet they can also facilitate implementation of projects as illustrated in this paper. Adaptation is much more than practices at the farm level, as it involves choices at national and international levels, as well as local (Burton and Lim 2005,

194-195). Cooperatives/associations here again can be essential intermediaries but above all give a voice to local communities.

Smallholder cooperatives/associations are playing an important role supporting the coffee production of their members and also climate change adaptation strategies. However cooperatives/organizations go beyond coffee production and in various ways support the livelihoods of their members and their communities. Smallholder cooperatives/associations also challenge underlying causes that have contributed to making farmers more vulnerable to climate change in the first place. Thus cooperatives/associations are in fact contributing to a production of coffee where social and ecological phenomena are linked together.

Not for nothing coffee has been named the “beverage of post-modernism” (qtd. in Lyon 2007, 241). As Lyn 2007 remarks, coffee is given this name to suggest that “it provides a window through which we can view a range of relationships and social transformations” (241), and as presented in this paper, smallholder coffee cooperatives/associations can indeed represent a social transformation. A transformation in which coffee is, and can be produced, linking social and ecological phenomena, resulting in sustainable ways of living, and farther reducing vulnerability to climate changes and facilitating ways to cope and adapt to those changes.

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