POLICIES AND INSTITUTIONS IN RWANDA'S COFFEE SECTOR

By

Andrew Gerard

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

Community Sustainability—Doctor of Philosophy

2020

ABSTRACT

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Coffee is a critical export for Rwanda and its over 350,000 coffee farming families. Despite great promise in terms of its agro-ecology and investments in quality upgrading, Rwanda has seen its production stagnate over the past two decades. In addition, coffee farmer incomes remain lower than in other East African countries. To promote the growth of the coffee sector, Rwanda's government has enacted policies aimed at increasing farmer productivity and improving the relationships between value chain actors. These approaches include centralized purchase and distribution of pesticide and fertilizer and a monopsonistic marketing policy called "zoning", which requires farmers to sell to specific coffee washing stations (CWSs), and CWSs to purchase coffee from specific farmers. Previous research found that while pesticide and fertilizer distributed improved generally since 2015, female-headed households were less likely to receive pesticide than male-headed households. It is also unclear whether zoning would improve fractious relationships between farmers and CWSs or provide CWSs with an opportunity to exploit farmers. While Rwanda's government implemented policies aimed at promoting coffee, multinational corporations have entered Rwanda's coffee sector as coffee exporters, purchasing, processing, and selling coffee onto the global market. They have consolidated exports while putting pressure on local export companies.

This dissertation includes three academic papers related to policies and institutions in Rwandan coffee. The first uses semi-structured interviews with exporters and other coffee sector experts to analyze the role of export companies in Rwanda's coffee value chain. This study describes

differences between local and international exporters in dealing with transaction costs, using the lens of value chain governance. The second uses a combination of a difference in differences analysis of survey data of coffee farmers and key informant interviews with CWS managers and officials to analyze the effect of Rwanda's zoning policy on services provided by CWSs to farmers. This study finds that zoning increased CWS promise and provision of second payments to farmers who were more affected by the policy. The final paper uses mental models designed based on problem tree exercises and focus groups with female household heads to better understand the challenges they face in profiting from coffee, particularly in relation to distributed inputs, and the solutions they believe could improve their production. This study finds that significant, interconnected challenges face female household heads, largely having to do with a lack of labor, lack of financing, and limited access to inputs. Participants designed numerous potential solutions, including collective action through women's associations, improved access to agricultural inputs, and more flexible financing options, among others.

ACKNOWLEDGMENTS

I first must thank Sarah Gerard, my wife, for allowing me to do a Ph.D., coming to Michigan, enduring snow and weeks of uninterrupted grey skies, and co-parenting our child (who was not particularly helpful with the dissertation, but was at least entertaining).

I am grateful for my parents for raising me to value education and providing encouragement throughout my educational experience. More to the point, though, I must thank my mother Nancy Gerard and my mother-in-law Sheila Nixon for helping Sarah watch our son while I was doing fieldwork in Rwanda.

My dissertation chair Dr. Maria Claudia Lopez has been a mentor, advocate, and friend, and I am incredibly grateful that she has been my advisor. The level of support and advocacy she has provided has been humbling. Thank you for teaching me about collective action, finding me funding, and traveling around Rwanda with me.

I am fortunate in who I have on my dissertation committee. Not because I have a "rock star" committee (though I do), but because the scholars on my committee are kind, insightful, and empathetic. Dr. John Kerr has provided advice and a listening ear and has been generous with edits. Both through her class and mentorship, Dr. Nicole Mason-Wardell has helped stretch my methodological capabilities. Dr. Aaron McCright has provided welcome insight from outside of agricultural development and economics and has been a helpful collaborator on papers beyond this dissertation.

While not on my committee, Dr. Dan Clay has been a mentor and guide to me while conducting my Ph.D. It is not an exaggeration to say that I came to Michigan State University because of

him. In 2013, when I was working in Washington, DC Dr. Clay took the time to provide me advice about coffee in Rwanda. In 2014, he attended a workshop on coffee that my organization hosted in Rwanda, and shortly thereafter we wrote a project proposal together. When I decided to attend MSU for my Ph.D., he suggested Dr. Lopez as my advisor and then paid for the first two years of my assistantship out of his own budget. During my time here, he has been a wise and generous mentor. More than everything he has done for me—which is a lot—Dr. Clay has provided a model for the sort of professional I want to be. Kind, passionate, driven by a desire to improve peoples' lives in material ways, and happy to be working.

Colleagues and friends in Rwanda have been critical to my development as a scholar and this research, and I am humbled to have the chance to work in their country and benefit from their expertise. Two people are specifically important to completing this dissertation: Dr. Alfred Bizoza and Bridget Vuguziga. Dr. Bizoza, a professor at University of Rwanda, sponsored my research permit in Rwanda, jumping through logistical hurdles at little benefit to himself. He has provided sound advice and insight on Rwanda's agricultural sector and I am fortunate to have had him as a sponsor. Bridget Vuguziga has been a collaborator on all original fieldwork I conducted for my Ph.D. Her determination, knowledge of Rwandan coffee, organization, humor, and energy are what made this field research possible.

In addition, I must thank Dr. Daniel Rukazambuga. He is a true friend and I will always be grateful for him helping to usher me into coffee research during my first visit to Rwanda in 2011 and guiding me through the complexities of working in Rwanda. Dr. Mario Serracin of San Francisco Bay Coffee has been a supporter of development and research in Rwanda's coffee sector since I started working there and has helped me with my own work consistently. Dr.

Joseph Bigirimana of Rwanda Agriculture Board, a talented entomologist and one of my favorite scholarly collaborators, has provided insight on the agro-ecology of Rwandan coffee. Finally, I must thank Bonaventure Nkurunziza, who helped Bridget and me with some of our final fieldwork activities.

Michigan State University faculty members outside of my committee have been helpful in providing advice. I am grateful to Dr. David Ortega for collaboration, advice, and friendship throughout this process. Thank you to Dr. Eduardo Nakasone who helped with methods for chapter 3. I gained insight from Dr. Tom Reardon, whose class on food systems organization inspired some of the initial thinking for chapter 3. Dr. Jenny Hodbod and Dr. Wenda Bauchspies provided advice on conducting interactive workshops in Rwanda and Dr. Laura Schmitt Olabisi provided feedback on mental models designed based on workshops with female household heads. Finally, separate from the dissertation specifically, Dr. Robert Richardson, Dr. Rebecca Jordan, and Dr. Kelly Millenbaugh have been helpful on my academic journey and I am grateful for their support.

I have been consistently impressed with the generosity of researchers external to MSU, many of whom have little to gain from helping. Dr. Ameet Morjaria (Northwestern University) provided advice on both chapters 2 and 3 and came to MSU for a lecture and meetings about my research. Dr. Ruth Meinzen-Dick (International Food Policy Research Institute) and Laura Meinzen-Dick (University of California, Davis) provided advice on data collection for chapter 4. Dr. Stephen Morgan (University of Florida) and Hal “The Hot Dog Guy” Gordon (University of California, Berkeley) provided advice on methods for chapter 3.

Graduate students—current and former—from the Department of Community Sustainability have been crucial to my development as a scholar. First and foremost, I must thank the Lopez Group, in particular Laura Castro Diaz, Rachel Nanteza, and Maria Alejandra Garcia, for help in honing ideas and reviewing early drafts of chapters. It is impossible to determine who exactly helped with what during this process, because so many insights came from chance conversations. However, graduate students who immediately come to mind include: Dr. Aniseh Bro—a colleague on Rwanda work and my first friend in CSUS, Dr. Timothy Silberg, who provided lots of advice, Dr. Udita Sanga, who provided last-minute advice on mental models, Rachael Belisle Toler, Kyle Metta, Ebenezer Ansah, Dr. Marie Schaefer, and Jessica Brunacini. It gives me great joy that so many of my friends now have "Dr." in front of their names.

Several organizations were involved in the Africa Great Lakes Region Coffee Support Program (AGLC), which this research builds on. I am grateful to my former employer the Global Knowledge Initiative for their support. The Institute for Policy Analysis and Research (IPAR)-Rwanda conducted the farmer survey that provides the backbone for much of this analysis. The University of Rwanda conducted fieldwork and later sponsored my research permit. Rwanda's National Council for Science and Technology processed my research permit. Felly Kalisa was particularly helpful and I am grateful for his support and patience. The Coffee Exporters and Processors Association of Rwanda (CEPAR) was helpful in availing information about input distribution in Rwanda. I am grateful to the National Agricultural Export Development Board (NAEB), the agency in charge of regulating Rwanda's coffee sector. Thank you to Deputy CEO Sandrine Urujeni, for meeting with me in Rwanda and challenging me to ensure that my research

is focused on improving the lives of Rwanda's farmers. Thank you as well to Dr. Celestin Gatarayiha, formerly of NAEB, who provided support and advice to the AGLC project.

I am grateful to organizations who funded my research. Much of my data comes from the AGLC project, which was funded by the Bureau of Food Security at the U.S. Agency for International Development through the Food Security Policy Innovation Lab at MSU. I am grateful to the Food Security Policy Innovation Lab for their support, in particular former director Dr. Mywish Maredia. I received additional funding from the Department of Community Sustainability; the College of Agriculture and Natural Resources; the Graduate School; and the Environmental Science and Policy Program, for which I am grateful. In addition to financial support, I am grateful to software company Kumu Inc. for a scholarship of free models.

Finally, and most importantly, I am grateful to the over 1,024 farmers who answered survey questions, the 25 representatives of exporters, and the 57 female household heads who gave of their time for this research. The knowledge that these individuals—many of whom have innumerable better things to do than answer my questions—believe that it is worth talking to me provides consistent motivation.

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CHAPTER 1: INTRODUCTION

Coffee is an important part of the global economy and—because high quality *Arabica* coffee can only be grown in equatorial regions—it is an important cash crop to the economies of developing countries and livelihoods of millions of developing country farmers (Daviron & Ponte, 2005). In some countries, such as Rwanda, it is also an enormous part of the economy and workforce. Coffee is Rwanda's most important export, and is grown by over 350,000 farming families, most of whom are smallholders (Clay, Bro, Church, Ortega, & Bizoza, 2018; The Observatory of Economic Complexity, n.d.). Based on research conducted for this study, the average coffee farming household has 5.3 people in it. This implies that over 1.8 million of Rwanda's 12.3 million people (approximately 14.6 percent of the population) may rely on coffee for at least part of their incomes (The World Bank, n.d.).

Rwandan coffee holds great potential from economic and agro-ecological perspectives. One reason for its economic promise is that Rwanda has the capacity to produce high quality "specialty" coffee (Clay et al., 2018). While most coffee globally is traded as a commodity and is priced based on coffee futures prices, specialty coffee is less directly connected to the whims of commodities markets (Clay et al., 2018). Rwanda's agro-ecology is well-suited for coffee, both in terms of rainfall and elevation, and likely resilience to climate change (Clay & Bizoza, 2018). While many parts of the coffee-growing world face serious threats from climate change, climate projections suggest that Rwanda may avoid decreased coffee production (Ovalle-Rivera, et al., 2015).

Despite these potential benefits, Rwanda's coffee sector has stagnated in terms of overall production over the past decade (International Coffee Organization, 2019). Furthermore, while

Rwanda produces specialty coffee, most farmers have failed to benefit from production, and make less money per kilo of coffee "cherry" than coffee farmers in neighboring countries (Clay et al., 2018). In addition, certain groups of farmers – for example female-headed households – face difficulties in sustaining themselves from coffee production.

In 2015, recognizing stagnating production over the past 20 years and a threat to coffee incomes, the U.S. Agency for International Development (USAID) funded the Africa Great Lakes Region Coffee Support Program (AGLC), a three-year project aimed at identifying opportunities to boost coffee productivity and improve quality. Michigan State University (MSU) researchers—including myself—collaborated with partners in Rwanda, Burundi, and the U.S. on this project between 2015 and 2018 to study opportunities to boost coffee productivity and improve coffee quality. The AGLC project conducted a large-scale farmer survey in Rwanda as well as qualitative data collection and interactive workshops with coffee sector stakeholders. This project and other studies conducted around the same time uncovered problems that motivated the analysis that makes up this dissertation.

The AGLC project identified farmer price as a primary influence on investment and productivity (Clay et al., 2018). However, AGLC researchers identified three other challenges that may influence the wellbeing of coffee farmers and the health of the coffee sector, and which inspired the research questions behind this dissertation. The first is the consolidation of Rwanda's coffee exports by multinational trading companies. Some qualitative data from interviews and workshops conducted through the AGLC project suggested that exporters may have been influencing Rwanda's government to keep farmer prices low (Clay et al., 2018). While other studies suggested that concentration in the sector was high, with around 70 percent of coffee

being exported by six companies (Behuria, 2019), accusations of exporter influence were anecdotal and did not differentiate between local and multinational exporters. In addition, there was little research on coffee exporters internationally, with some of the most important studies nearly 20 years old and not directly relevant to Rwanda's case (Ponte, 2002).

The second issue relates to a policy implemented in Rwanda in 2016 that restricts fresh coffee sales by farmers. Rwanda's zoning system requires farmers within geographic zones to sell to specific coffee washing stations—mills that purchase and process coffee—and bans sales or purchases outside of zones (Gerard, Clay, & Lopez, 2017). The stated purpose of zoning was to improve relationships between farmers and buyers, reduce the activities of middlemen in selling coffee, and improve traceability (National Agricultural Export Development Board, 2016). Prior to zoning, coffee washing stations (CWSs) used relational contracts and provision of services to attract farmers (Macchiavello & Morjaria, 2019). When zoning was first implemented, farmers and some exporters were unhappy with the policy (Gerard et al., 2017). While some evidence suggests that such a system could improve relationships between farmers and buyers (Sukhtankar, 2016; Theriault & Tschirley, 2014), examples of government-mandated regional zoning systems are uncommon in coffee and it was unclear whether the policy would help farmers or allow for greater exploitation by buyers.

The third issue relates to challenges faced by a specific sub-set of farmers, female household heads, who made up approximately 35 percent of Rwandans in 2010 and 18.5 percent of farmers in our survey conducted in 2015 (Daley, Dore-Weeks, & Umuhozac, 2010). Earlier research found that female household heads had smaller farms, made less money from their coffee, and were less likely than male household heads to receive government-distributed pesticide (Gerard,

Clay, Lopez, Bowman, & Rukazambuga, 2018; Lopez & Church, 2017). While their poverty and smaller farms were not surprising based on their widowhood (Bozzoli & Bruck, 2009; Kennedy & Haddad, 1994; Schramm et al., 2018), the gap between male and female household heads in use of distributed pesticide was perplexing. Rwanda's input distribution system should provide pesticide to all farmers based on the number of trees they own. In workshops, respondents suggested that women may be less likely to use pesticide due to health and cultural reasons. Some respondents suggested that women may not be able to access pesticide sprayers. While there is robust research on challenges women face in cash crop production in Africa, we found little in the way of discussions of pesticide use (Peterman, Behrman, & Quisumbing, 2014). However, some studies suggested that government provision of inputs or input vouchers can be badly targeted and miss vulnerable populations (Jayne, Mason, Burke, & Ariga, 2018; Kilic, Whitney, & Winters, 2015).

The three dissertation chapters respond to these challenges. Chapter 2: "*Relational contracts and value chain governance structures: coffee exporter approaches to overcoming transaction costs"*, focuses on the role of exporters in Rwanda's coffee sector. This paper describes (1) barriers faced by Rwandan private, Rwandan farmer cooperative-owned, and foreign exporters and (2) the approaches these exporters use to overcome barriers. Interviews were conducted with representatives of these three exporter types, as well as knowledgeable coffee sector stakeholders. I find that Rwandan private and cooperative-owned exporters face difficulties in accessing capital, competition to purchase fresh coffee despite policies to eliminate competition, and high transaction costs. They rely on government for support, use relational contracts to overcome transaction costs, and benefit from the zoning policy that reduces competition for fresh

coffee. Foreign exporters primarily face regulatory challenges: a government-set coffee price and the same zoning policy that protects local exporters. They vertically integrate to overcome transaction costs and lock in suppliers through pre-financing and legal action.

Chapter 3: *"Do government monopsony policies improve buyer-farmer relationships? Evidence from Rwanda's coffee sector*" focuses on the effect of zoning on service provision by coffee washing stations. Farmer surveys from before and after zoning implementation are used to estimate a difference-in-differences regression analyzing the effects of zoning on "second" payments paid to farmers out of CWS profits. Knowledge of zoning and geographic variables are used as proxies for the relative strength of zoning implementation. I analyze the effect of these variables on being promised or receiving second payments. Interviews with CWS managers and government representatives support quantitative findings. I find that farmers who knew about zoning in 2017 saw an increase in the odds of being promised or receiving second payments relative to farmers who did not know about zoning. Living in areas with less stringent zoning implementation in 2017 reduced the odds of farmers being promised or receiving second payments. Interviews with CWS managers suggest that zoning motivated CWSs to provide second payments and other services.

Chapter 4: *"Perspectives of female coffee farmers in Rwanda: Identifying problems and developing solutions for coffee production"* both describes the problems faced by female household heads in coffee production and identifies their proposed solutions to these problems. As noted, Rwandan female household heads face challenges in profiting from coffee, and specifically face problems accessing government-distributed pesticide. To understand what might be keeping female household heads from profiting from their production and identify potential

solutions to these problems, workshops were conducted with six groups of female household heads in Rwanda's Southern Province. A problem tree tool was used to identify top problems and causes of these problems. Focus groups were then conducted, in which female household heads identified potential solutions. Results of workshops were analyzed alongside survey data collected by the AGLC project. I find that labor costs, financing, and inputs are some of the biggest barriers facing female household heads. Underpinning these challenges are discrimination and social norms which hamper female HHHs' ability to invest in their farms. Solutions focused on forming women's organizations, increasing access to financing, improving input distribution, and increasing access to domestic animals that can serve as assets. This paper also provides insight on reasons female household heads are less likely to receive distributed pesticide; these have to do with a lack of information about pesticide availability, limited labor to spray pesticide, corruption by local distributors, among other issues.

Findings from this dissertation are both theoretically, practically, and methodologically important. They are most obviously important for decision-making by Rwanda's government and Rwandan coffee sector stakeholders. These findings shed light on issues important to exporters, farmers, and cooperatives, among others. However, findings may be relevant to other developing country cash crop value chains and, in particular, coffee production in developing countries. In addition to these practical contributions, it advances theory and methods related to the new institutional economics, value chain governance, and gender in agriculture.

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CHAPTER 2: RELATIONAL CONTRACTS AND VALUE CHAIN GOVERNANCE STRUCTURES: COFFEE EXPORTER APPROACHES TO OVERCOMING TRANSACTION COSTS

2.1 Introduction

Export companies are essential actors in global value chains for commodities such as coffee. They purchase goods in producing countries, and facilitate exports to importers or buyers in consuming countries (Baglioni, 2015; Ponte, 2002). In some cases they can be thought of as "lead firms" that govern global value chains, insofar as they are vertically integrated with multinational corporations (MNCs) (Daviron & Ponte, 2005; Ponte, Kelling, Jespersen, & Kruijssen, 2014). They are important actors even when their role is constrained to buying and then selling commodities to global traders or importers; as middlemen they can extract rents and influence the institutional context in which they work. In the case of coffee, despite their important functions, exporters have received relatively little attention, with more studies focusing on production (Bolwig, Gibbon, & Jones, 2009; Ibanez & Blackman, 2016; Mujawamariya, D'Haese, & Speelman, 2013; Ruben & Fort, 2012). The lack of research on coffee exporters is surprising, because particularly in East Africa they are perceived as influential in national coffee sectors (Clay et al., 2018; Daviron & Ponte, 2005).

The concept of global value chains (GVCs) is influential in studies of economic development and can help in understanding exporters (The World Bank, 2019). GVC research focuses on "how global industries are organized by examining the structure and dynamics of different actors involved in a given industry" (Gereffi & Fernandez-Stark, 2016, p. 6). GVC research focuses in part on how lead firms and other actors engage in upgrading value chains. Upgrading is a concept that "refers to the constellation of ways in which firms can enhance their

competitiveness through investments in productivity, specialization, and knowledge-intensity" (Pipkin & Fuentes, 2017, p. 536).

Exporters play a particularly important role in countries where value chains are in the process of upgrading, such as Rwandan coffee (Behuria, 2018; Daviron & Gibbon, 2002). As a matter of economics and policy, Rwandan coffee has moved from being primarily commodity-quality to increasingly becoming "specialty" coffee (Behuria, 2018; Clay et al., 2018). Specialty coffee is high-quality coffee, generally of the *arabica* variety, which sells for higher prices than commodity-grade coffee (Clay et al., 2018). In the GVC literature, this can be seen as a "product" upgrade in that the quality of the product improves (Bamber, Guinn, & Gereffi, 2014). Coffee is one of Rwanda's most important agricultural exports, grown by over 350,000 farming families (Clay et al., 2018). Smallholder farmers grow coffee on their farms, and then either home-process "parchment"[1] or sell cherries to coffee washing stations (CWSs) (Clay et al., 2018). CWSs are mills that purchase coffee cherries from numerous farmers, process them, and then sell them to exporters. Over the past two decades, Rwanda's government has focused on upgrading the coffee sector through quality improvements, and encourages farmers to sell to CWSs rather than home-processing (Behuria, 2018; Clay et al., 2018). Despite substantial private and donor investment, Rwanda's coffee production has stagnated and farmer prices are some of the lowest in East Africa (Clay et al., 2018). While the percent of coffee sold as specialty has increased, benefits do not seem to be accruing to Rwandan farmers, CWSs, or exporters (Clay et al., 2018; National Agricultural Export Development Board, 2016a).

1 Parchment is coffee which has had the cherry skin and pulp removed, and which has been dried and is prepared for hulling at a dry mill (Daviron & Ponte, 2005).

Prior to coffee sector liberalization in the early 2000s, Rwandan coffee was exported by a government-owned firm (Behuria, 2018; Boudreaux, 2011). However, since liberalization, local investors, foreign traders, and farmer cooperatives have moved into exporting coffee (Behuria, 2018). Many coffee sector stakeholders perceive exporters to have outsized influence on coffee policy and some have expressed concern about an industry takeover by large exporters (Behuria, 2018; Clay et al., 2018). Indeed, several companies—primarily MNCs but including large Rwandan exporters—have consolidated exports, and six firms export 70% of Rwandan coffee (Behuria, 2018).

By consolidating the sector and squeezing out Rwandan exporters, foreign exporters may capture the benefits of upgrading coffee quality (Vicol, Neilson, Hartatri, & Cooper, 2018). Vertically integrating from CWSs in Rwanda to roasters in Europe or North America allows MNCs can capture a greater share of value addition even while exporting an upgraded product. MNC domination of the sector could challenge the notion that upgrading is indeed benefiting Rwanda's coffee sector. A 2017 review of GVC upgrading suggested that "treadmilling"—upgrades followed by "backsliding, decay, and obsolescence"—were often associated with "high buyer dependence, low local institutional capacity… outsourcing of knowledge-intensive activities, and adoption of easily imitable upgrades" (Pipkin & Fuentes, p. 537). An important question is whether this is happening in Rwanda.

In regulating the coffee sector, Rwanda's government balances protecting Rwandan businesses and farmers with creating a conducive environment for foreign investment. Indeed, Rwandan economic and agricultural policies are welcoming for foreign direct investment and this is a priority for economic growth (Rwanda Ministry of Agriculture and Animal Resources, 2013;

Rwanda Ministry of Finance, 2013). In addition, the agency that regulates coffee—the National Agricultural Export Development Board (NAEB), an agency under Rwanda's Ministry of Agriculture and Animal Resources—is also tasked with guiding foreign investment into export crops (National Agricultural Export Development Board, 2019).

This paper considers the role and diversity of exporters in Rwanda's coffee sector by exploring the barriers faced by exporters—Rwandan and foreign—and their relationship-based and value chain governance strategies for overcoming these challenges. In doing so, we analyze the extent to which Rwandan exporters face pressures from MNC competitors, and describe the pressure MNCs perceive from government. The following two questions guide this study: (1) What challenges do Rwandan private, cooperative-owned, and foreign coffee exporters face? Specifically, how do these challenges differ among these different types of exporters? (2) How do different types of exporters address these challenges? In particular, how do their approaches to addressing these challenges differ?

In answering these questions, this paper contributes to literature in three ways. First, as noted, there has been little research conducted on coffee exporters, and studies that do reference exporters rarely go into detail on their structures or behavior in value chains (Behuria, 2018; Clay et al., 2018; Ponte, 2002). Second, this paper contributes to the body of evidence on how contracting and GVC governance structures are used to overcome transaction costs in developing countries (Fafchamps, 2004; Gereffi, Humphrey, & Sturgeon, 2005; Key & Runsten, 1999; Morjaria & Macchiavello, 2015). Finally, it serves as a case study of a government and donor-supported attempt to upgrade a value chain using foreign investment that may end up backfiring if MNCs drive out local exporters and capture value addition (Pipkin & Fuentes, 2017).

2.2 Literature Review

2.2.1 Transaction costs and value chain organization

Agricultural, manufacturing, and trade-based value chains in Sub-Saharan Africa often face institutional challenges related to contract enforcement and high transaction costs (Fafchamps, 2004). These challenges, which complicate trading, have been well-described within the agricultural economics literature, often using a New Institutional Economics (NIE) lens (Schmid, 2004). High costs of information (Fafchamps & Minten, 1999; Key & Runsten, 1999; Maertens, Colen, & Swinnen, 2011) and difficulties for contract enforcement (Banerjee & Duflo, 2000; Gerard, Lopez, Clay, & Ortega, 2020; Morjaria & Macchiavello, 2015) are particularly challenging for exporters in GVC for commodities such coffee.

In coffee, high information costs relate to the quality and provenance of coffee and trustworthiness of partners. Coffee quality is a high information cost good because coffee cannot be cup-tested until it is processed; thus, it is difficult to know the quality of cherries being purchased at a CWS. The risk of a trading partner reneging on a contract or holding up the trading partner involves both high information costs and high enforcement costs. Hold up refers to breaking an agreement in a trading relationship and "holding up" either payment or the product that has been paid for (Cungu, Gow, Swinnen, & Vranken, 2008). It occurs when one actor chooses not to follow an agreed-upon structure for trade, with the result that the other actor is exposed to "ex post costs and risks related to their sunk investments in relationship-specific assets." (Cungu et al., 2008, p. 77). It is difficult to know whether your trading partner is trustworthy and—if they are not—it is costly to take them to court.

Relational contracts can assist in overcoming both high information costs and high enforcement costs. Relational contracts involve using relationships, reputation, and reciprocity to contract when agreements are costly to enforce (Banerjee & Duflo, 2000; Fafchamps & Minten, 1999; Morjaria & Macchiavello, 2015). In addition, long-term relationships between trading partners can be an important way to share complex information (Gereffi et al., 2005). Even in contexts with high enforcement costs, it may be possible to enforce contracts or ensure supply of produce through legal action, monopsony buying systems, or vertical integration (Gereffi et al., 2005; Key & Runsten, 1999; Maertens et al., 2011; Sukhtankar, 2016).

In discussing GVC governance structures, Gereffi, Humphrey, and Sturgeon describe two ways that value chains can organize to control quality and reduce transaction costs: hierarchy (vertical integration) and captive value chains (2005). In combination with relational contracts, these are helpful concepts for understanding exporter behavior. Hierarchy is "characterized by vertical integration" and its governance involves "managerial control, flowing from managers to subordinates, or from headquarters to subsidiaries and affiliates" (Gereffi et al., 2005, p. 84). In captive value chains, *"*small suppliers are transactionally dependent on much larger buyers" and "face significant switching costs." (Gereffi et al., 2005, p. 84). While Gereffi et al. do describe "relational" value chain governance, this is a distinct concept from the relational contracts described in NIE. As Ajwang suggests, few papers have connected concepts from GVC and NIE, despite GVC and NIE using similar concepts and language (2019). This paper exploits these complementarities to describe exporter behavior.

2.2.2 Studies on exporters

While substantial research has been conducted on GVC governance and contracting in developing countries, there is less research on coffee exporters as value chain actors. One reason for this may be that exporters' roles have changed over time. In a 1997 paper discussing the global coffee value chain, Talbot described the processing and exporting stages of coffee production as being locally-owned while import and roasting were often controlled by MNCs (Talbot). In 2005, Daviron and Ponte suggested that international traders globally were beginning to vertically integrate down into processing and exports.

In 2002, Ponte described a gap in coffee research related to "the identity, market share and organization of actors involved in commodity markets and their contractual relationships upstream (towards producers), downstream (towards consumers) and sideways (with providers of inputs and services)…" (p. 250). This was written in the context of an analysis of coffee exporters in Kenya, Tanzania, and Uganda. However, it remains true that little research has focused on coffee exporters and their relationships toward processors or farmers, toward importers, or—in the case of Rwanda—with government. Baffes (2006) studied local exporters in Uganda's *robusta* coffee sector, and the consolidation of that sector as smaller, less sophisticated exporters failed because of price fluctuations. However, Uganda's coffee sector did not exhibit as high a level of MNC activity as Rwanda, and *robusta* coffee is less quality-differentiated than specialty *arabica* coffee (Baffes, 2006; Daviron & Ponte, 2005). While many recent papers reference or generally describe coffee exporters, few analyze them specifically (Bro & Clay, 2017; Gelaw, Speelman, & van Huylenbroeck, 2017; Giuliani, Ciravegna, Vezzulli, & Kilian, 2017; Vicol et al., 2018).

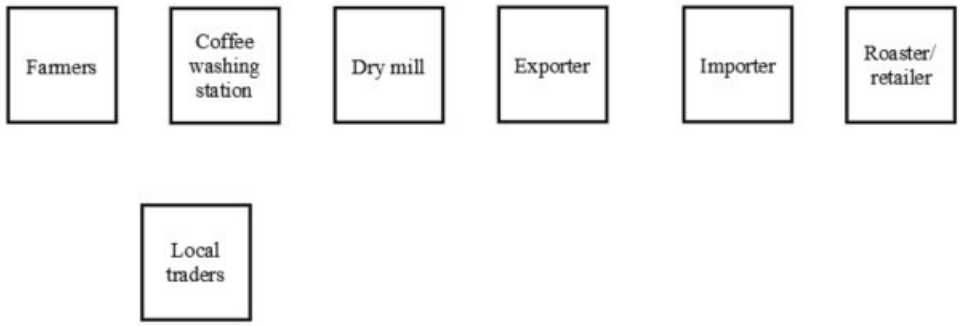
A more specific gap has to do with the role of exporters within Rwanda's coffee sector. Exporters have been described has having an outsized influence on regulators, and specifically to have advocated for low farmer prices (Clay et al., 2018). However, aside from work by Behuria (2018), little analysis has focused specifically on their structure and performance.

2.3 Background on Rwanda coffee sector

2.3.1 Exporters

In Rwanda, exporters purchase coffee from CWSs and sell to importers or roasters in consuming countries, or to other exporters in Rwanda who in turn sell to foreign buyers. Under different organizational structures exporters may own CWSs and may in turn be owned by MNCs with import arms. While many CWSs are owned by exporters, others are owned by local companies or cooperatives and sell coffee to exporters. If an exporter owns the CWS, they purchase fresh coffee cherry from farmers or from coffee traders (though this has become less prevalent, because of the zoning policy described in the next section). If they do not own a CWS, they purchase parchment coffee from CWSs. After wet milling at a CWS, coffee is hulled at a dry mill, which renders the "green" coffee that is sold to international buyers for roasting in consuming countries (Daviron & Ponte, 2005). Upon hulling the coffee, exporters manage export paperwork and ship green coffee to the port at Mombasa, Kenya, where the coffee is shipped to its destination for roasting. See Figure 1 for a simplified visualization of the Rwanda specialty coffee value chain.

Figure 1: Simplified Rwanda specialty coffee value chain



Sources: The authors; Clay et al., 2018; Macchiavello & Morjaria, 2015; Behuria, 2018

2.3.2 Key policies in Rwanda's coffee sector

Understanding the challenges and opportunities facing exporters in Rwanda's coffee sector requires understanding two important policies: the zoning policy and farmgate price.

The 2016 zoning policy aims to improve relationships between CWSs and farmers through a monopsony system in which farmers must sell to specific CWSs, and CWSs must purchase coffee from those farmers (Gerard et al., 2017; National Agricultural Export Development Board, 2016b). The policy was developed in response to what government and researchers saw as a breakdown in relational contracts between farmers and CWSs (Macchiavello & Morjaria, 2015). Additional goals for the policy were to improve coffee traceability, protect CWSs that may fail financially because of competition, and reduce the influence of middlemen (National Agricultural Export Development Board, 2016b).

With the advent of specialty coffee in Rwanda in the early 2000s, there were often positive, mutually beneficial relational contracts between CWSs and farmers (Macchiavello & Morjaria, 2015). Macchiavello and Morjaria describe an interlinked system, in which CWSs provided pre-financing and inputs to farmers, who sold them cherry with a recognition that they would receive part of their payment up front, and part as a "second payment" after the CWS had sold coffee

(2015). However, due to increasing competition between CWSs, relational contracts broke down. Some farmers would take pre-financing or other services and then side-sell cherry to traders or other CWSs, and CWSs began refusing to provide pre-financing or second payments (Macchiavello & Morjaria, 2015). This in turn incentivized farmers to sell their cherry quickly traders or competing CWSs for cash rather than waiting for a second payment that might not appear.

One of the zoning policy's goals is to improve relationships between farmers and CWSs (National Agricultural Export Development Board, 2016b). While CWSs are not required to provide farmers with pre-financing or second payments, because they cannot purchase coffee from outside of their zone and no longer face the threat of side-selling, Rwanda's government hopes that they will provide services to farmers (Africa Great Lakes Region Coffee Support Program, 2017). Because many exporters own CWSs and rely on geographically dispersed farmers for cherry, this policy constrains them. Under zoning, they cannot legally access more cherry than is within their zones' boundaries.

Another relevant policy is the farmgate price. Rwanda's government has put in place a set price per kilo of cherry purchased by CWSs, commonly known as the "farmgate price" (Clay, et al., 2018). The farmgate price is calculated based on the estimated farmer cost of production in Rwanda, and global coffee prices (Ntirenganya, 2019). Districts can set local farmgate prices which are higher than the national farmgate price, if coffee in the District is in sufficient demand that they can afford this. With the advent of zoning, the government encourages CWSs to pay exactly the District-level farmgate price for a first payment, with the option of paying a second

payment, so as to dissuade CWSs from competing for cherry and "breaking" the zones (Africa Great Lakes Region Coffee Support Program, 2017).

The role of exporters in the value chain is contentious in part because of their purported influence on farmgate prices—keeping them lower than farmers would like (Clay et al., 2018). While farmgate prices now are set based on a formula, in the past exporters and farmer groups negotiated with NAEB over prices. Farmgate prices have fluctuated substantially: from 150 RWF ($0.20 USD) per kilo of cherry in 2016, to 249 RWF ($0.31 USD) in 2017, to 267 RWF ($0.31 USD) in 2018 when most exporter interviews were conducted, to 190 RWF ($0.21 USD) in 2019 (Ntirenganya, 2019; The New Times, 2017; XE, 2020)[2].

2.4 Methods

2.4.1 Data collection

During fieldwork for this paper in 2018 and 2019, we conducted 29 semi-structured interviews. In sampling for these interviews, we had two considerations: including the most influential exporters and having a diversity of exporters in terms of size, location, and ownership type. We asked five individuals knowledgeable about the Rwandan coffee sector to identify the exporters they believed were most important in terms of size or influence in the sector. Based on exporter reputation, we identified eight exporters to include in analysis. In addition, we sampled 22 exporters from the 69 registered exporters using a random number generator for a full initial sample of 30 exporters. If an exporter was not able to be contacted or refused to be interviewed, we substituted another exporter in its category (see below) using a random number generator. Of

2 Exchange rates as of January 1 in each year in question. The Rwandan franc has weakened against the US dollar in recent years.

the 69 registered exporters in Rwanda, we ultimately sampled a total of 34 (49.3%) and interviewed 25 (36.2%).

Interviewed exporters fall into three categories: Rwandan private exporters, Rwandan cooperative-owned exporters, and foreign exporters. Initially, we used a larger number of categories for Rwandan private companies based on whether they owned CWSs (hypothesized to be an indicator of size) and where they were located. However, in analysis it became clear that combining these sub-categories was a better approach because there was little differentiation between categories of Rwandan exporters compared to other categories.

Representatives from 24 export companies and one non-governmental organization (NGO) with knowledge of the coffee sector were interviewed in 2018. Exporter representatives interviewed were generally the exporters' owner or manager. In the case of MNCs, these were generally the in-country manager. In 2019, we conducted three additional interviews with stakeholders aimed at triangulating findings from the initial interviews, and one interview with a cooperative-owned exporter. Stakeholders interviewed included a representative of an international coffee buyer and representatives of two NGOs. These individuals were chosen because of their interactions with exporters and ability to support or challenge findings from exporter interviews.

The first author interviewed 21 of 29 interviewees in English. During the process, we worked closely with a Rwandan research assistant who was trained to conduct interviews in Kinyarwanda. She conducted eight interviews. Of English interviews, fifteen were recorded with the authorization of the respondent and then transcribed. Six interviewees preferred not to be recorded. Most semi-structures interviews were conducted in Kigali, Rwanda's capital. Two

interviews were conducted outside of Kigali, at rural CWSs. In addition, two interviews were conducted over Skype from the U.S.

2.4.2 Data analysis

We analyzed data during and after the fieldwork. After the fieldwork, for the interviews done in Kinyarwanda, our research assistant transcribed and translated them into English; for the interviews in English the first author transcribed them. We then started a data condensation stage (Miles, Huberman, & Saldana, 2014). We created a codebook using the NIE and GVC literatures, and emergent themes from the research. Key categories of analysis included challenges faced by exporters, challenges faced by the coffee sector, relationships with government, relationships with the exporter association, relationships with farmers, and contracting approaches, among others. We coded the full transcripts of interviews using NVivo. We created memos for each interview, and across codes which allowed for analysis across and within interviews. We do not present counts of respondents, instead presenting the rough scope of agreement or disagreement on topics (Patton, 2002).

Table 1 presents an overview of organizations interviewed. In addition to exporters, there are categories for stakeholders interviewed.

Table 1: Organizations represented in interviews

	2018 Interview	2019 Interview	Total
Exporter interviews			
Private Rwandan	15	0	15
Cooperative-owned	4	1	5
Private foreign	5	0	5
Subtotal exporters	*24*	*0*	*25*
Additional interviews for triangulation			
Stakeholder (NGO, buyer, etc.)	1	3	4
Total:	25	4	29

In presenting results, we include illustrative quotes from interviewees. We use a code for the exporters to retain confidentiality. Respondents numbered P 1-15 are the 15 Rwandan private exporters, C 1-5 are the five cooperative-owned exporters, and F 1-5 are the five foreign exporters.

2.5 Results

Results are organized into (1) differences between private Rwandan, cooperative-owned, and foreign exporters, followed by (2) analysis of challenges faced by each, and finally (3) their approaches to solving these challenges.

Exporters have different structures, levels of vertical integration, and sizes, which influences the challenges they face and how they confront these challenges. The main structural aspects that we investigated were the ownership of the exporter, how much coffee they export, and vertical integration: whether they own CWSs and/or dry mills and whether they are connected to a foreign importer. See table 2 for an overview of types of exporters interviewed.

Table 2: Organization of private Rwandan, cooperative-owned, and foreign exporters

	Ownership structure	**Average # containers sold (approx. 37,500 lbs. each)**	**CWS**	**Dry mill**	**Foreign importer**
Private Rwandan (15 total)	9 sole proprietorship; 5 partnership; 1 holding company.	Avg.: 23 containers. Range: 0-100+. One exporter did not divulge.	9 own CWSs. Most own between 1-4 CWSs.	5 own a dry mill.	2 vertically integrated with importer (neither are MNCs).
Cooperative (5 total)	Owned by members.	Avg.: 15 containers. Range: 3-40+. One exporter did not divulge.	All own CWSs.	1 owns a dry mills. One exporter did not divulge.	0 integrated with foreign importers.
Foreign private (5 total)	3 MNCs; 2 sole proprietorship.	Avg.: 109 containers. Range: 0-200+.	3 own CWSs.	3 own a dry mill.	4 vertically integrated with importer (3 are MNCs).

2.5.1 Challenges faced by exporters

Rwandan private exporters

Rwandan private exporters discussed the challenges they face and challenges across the Rwandan coffee sector. Accessing financing is a primary challenge**,** noted by several exporters. Exporters need financing to operate CWSs, pay farmers for cherry, and purchase processed coffee from CWSs. Exporters noted that banks see loaning money to exporters as risky and hedge against this risk by requiring substantial collateral. Even after getting approval for a loan, there are delays in receiving financing and delays in knowing whether financing will be available.

Several exporters suggested that despite the zoning policy aimed at restricting competition, buyer competition raises cherry prices. Competition for cherry is not allowed under the zoning policy, however our own research suggests that at the time of this research, zoning had only partially been implemented and had not be implemented in the same way across regions (Gerard, Lopez, Mason, & Bizoza, 2020). Some exporters also expressed concern at the threat of foreign exporters to the market, suggesting they have substantial power and drive cherry prices up through competition at the CWS level. A minority of respondents said that MNCs have an easier time finding buyers because of their trading operations outside of Rwanda.

A minority also noted hold up, reneging, or fraud buyers as a challenge. For example, one informant (P4) said: "[It is] difficult to identify who is the real buyer because there are some ones who pretend to be buyers yet are thieves; they come and take our coffee neglecting that it is for farmers." Indeed, high information costs abound for private Rwandan exporters, and respondents regularly mentioned the importance of having information on or trusting groups they work with. Several Rwandan private exporters suggested that costs of information are high for coffee quality because quality cannot be gauged until coffee has been processed and roasted. Some exporters suggested that owning CWSs can mitigate these problems because they can implement quality control procedures from the time the farmer bring the coffee to the CWS; others suggest the importance of visiting farms/mills of suppliers to better understand their production. Additional problems noted include high cherry prices and low global prices.

When asked about the most important challenges in the sector, Rwandan exporters noted coffee quality and low farmer investment. Some of the same challenges that exporters noted for

themselves are also challenges they perceive for the sector, such as getting financing, delays in financing, finding buyers, low global prices, and exporter competition.

Rwandan cooperative-owned exporters

Challenges facing Rwandan cooperative-owned exporters were similar to those faced by private Rwandan exporters. For example, financing was also the primary challenge identified by representatives of cooperative-owned exporters. Specifically, representatives noted difficulty in getting loans and delays in receiving loan money. One cooperative representative suggested that some cooperatives receive pre-financing from MNCs, and then are unable to pay back their loans and have their CWSs seized.

Several cooperatives suggested that competition raises cherry prices, but some also said that zoning has limited competition. Cooperatives and private exporters were similar in their concerns about competition. However, a difference is that cooperatives also talked about competition with MNC exporters on the export market, not solely competition between CWSs for cherry. Cooperatives were also more explicit about their concern with consolidation happening in the export sector. Some were negative about MNCs, suggesting that MNCs could sell on the international market for lower prices and some were concerned about their level of vertical integration.

A minority of cooperative representatives suggested that finding new buyers is a challenge. One said this is particularly difficult given high prices for Rwandan coffee on the international market compared to low global prices. While less of a concern than for private Rwandan exporters, some suggested difficulties in being able to trust buyers.

When asked about the biggest challenges facing the coffee sector, cooperatives noted similar issues for the sector that they did for their own businesses. They added that the lack of inputs for Rwandan farmers, specifically mulch, hampered farmer investment.

Foreign exporters

Foreign exporters differed substantially from Rwandan exporters in the challenges they faced. While foreign exporters noted that competition exists and that it was not eliminated by zoning, they did not discuss it as a serious challenge to business. Rather, the most common challenge discussed by foreign exporters was what they perceived as a high farmgate price. Representatives of all foreign companies were negative about high farmgate prices, citing comparably low global prices. Some said they would reduce purchases of Rwandan coffee because of the high price, and aside from one high-end exporter, they said that they were losing money at current prices. A majority said that NAEB does not host meetings to discuss the price—something NAEB used to do prior to announcing the farmgate price, with some exporters frustrated that they no longer have a say in price setting.

Foreign exporters were mixed on whether a government-set farmgate price was necessary at all. Some said that the farmgate price was unnecessary because of competition, however one suggested that it was only necessary in parts of the country with few CWSs. Just one said it is necessary because the government encourages high quality coffee, and high farmgate prices encourage CWSs to select higher grade coffee.

Relative to other respondents, foreign exporters claimed that zoning negatively impacted business. Most said that there is high competition and side-selling, implying that they believe

zoning has been unsuccessful. One (F1) suggested that zoning harmed farmers and would be unsuccessful:

> "I think competition is the best thing for the farmers. The zones were [designed] to try and eliminate it, but in a district like Nyamasheke where there's 60 washing stations in a small area, zoning will never, ever succeed. It just won't happen."

Some respondents said that farmers who previously supplied them had been assigned to another zone. Only one person said something positive about the policy; they liked zoning "in theory" but did not know how it was working.

In addition to criticizing specific policies, foreign exporters made negative statements about NAEB itself, with a majority describing contentious communication that they had with NAEB about policies, in particular the farmgate price. One respondent (F3) illustrated these difficulties:

> And the relationship with NAEB is becoming more and more difficult. The distance between us and them is becoming bigger. So in the past, how the regulation and decisions were made, sometimes they were inviting us to discuss. They would listen to our ideas and decide. Now they don't. There is no regular communication... It's like we don't understand each other. So that's how it is. And so what we do is just follow the regulation. If you can survive, fine. If you fall down, you are finished.

It is unclear to what extent this negativity was because of differences of opinions between foreign versus Rwandan exporters, and the extent to which foreigners may feel at liberty to criticize the government relative to Rwandans.

Though not as serious a challenge as high farmgate prices or zoning, representatives of most foreign exporters complained about farmers or CWSs reneging on contracts. In some cases, exporters were confused as to why farmers agreed to a deal and then did something else. One of these exporters (F4) said:

> We used to do contracts for 5 years minimum. But we find [that] they don't follow the rules. We do yearly now. It is hard for us, or for the cooperative it is hard to

> follow the contract. We can invest and then someone else will come and they will change their mind. There is no loyalty, even if you invest time and education.

Much of the concern about suppliers reneging on agreements came from the smallest foreign exporters. One larger exporter said that they initially had problems with side-selling, but quickly resolved them by taking CWSs to court. As in buyers reneging on contracts (noted by Rwandan exporters), suppliers reneging may be an example of high enforcement costs. The smallest foreign exporters had the biggest problem with reneging and are in the worst position to use the court system to enforce contracts due to limited capital and organizational capacity.

Finally, some respondents mentioned difficulties in getting good rates in financing. However, they do not seem to have the same challenges as Rwandan firms in terms of not accessing loans or having delayed loans.

As is the case with Rwandan exporters, when asked about the primary challenges facing the sector, foreign exporters mostly noted the same problems they identified for their businesses. However, they were also concerned about management competence in the value chain, specifically with Rwandan companies that they believe have weak professional standards.

Stakeholder perspectives on challenges faced by exporters

Interviewed stakeholders commented on several challenges identified by Rwandan (private and cooperative-owned) and foreign exporters. In terms of challenges facing Rwandan exporters, stakeholders described structural differences between MNCs and Rwandan exporters. Because of their vertical integration, MNCs have better knowledge of global markets, an ability to choose which coffees are in blends (and reduce purchases of Rwandan coffee if prices are high), and better financing lines. While foreign exporters have an advantage in competing for cherry, all

stakeholders believed that competition for cherry at the CWS level has decreased because of zoning.

Some stakeholders were concerned about MNC consolidation of the sector. One said that due to consolidation, the only exporters remaining in Rwanda were MNCs, two large local firms, and "a couple of guys hustling." Others were less concerned, one because vertical integration and consolidation are "normal" parts of business, and another because they believed consolidation may be slowing. One stakeholder suggested that while MNCs are consolidating parts of the sector, Rwandan exporters are too fragmented, lack economies of scale, and should merge to compete with MNCs.

Some stakeholders suggested that a problem facing Rwandan exporters is that they do not understand MNCs. For example, one said that contracts cooperative exporters receive from MNCs were fair, but that cooperatives did not understand the contracts and believed they were being exploited.

Stakeholders also discussed challenges identified by foreign exporters, agreeing that many foreign exporters have contentious relationships with NAEB. While stakeholders were more amenable to high farmgate prices than foreign exporters, some stakeholders said that the process for setting the farmgate price is opaque. Stakeholders were more positive about zoning than foreign companies because they believed it reduces competition for cherry. An area of agreement between stakeholders and foreign exporters was on weak management skills by local value chain actors. Several stakeholders suggested that this was an important problem, focusing on quality control and transport issues.

2.5.2 Approaches to addressing challenges

There are two primary ways that exporters seek to solve the challenges they face: (1) through affiliation with government and non-governmental organizations; and (2) through value chain governance and contracting approaches.

Support from government and business associations

As discussed, NAEB is the government regulator serving the coffee sector. The Coffee Exporters and Processors Association of Rwanda (CEPAR) is a business association that serves exporters. We might expect that, as an engine of collective action for diverse local and international exporters, exporters would rely on CEPAR to represent their interests and NAEB would represent the interests of the government, farmers, and the broader economy. However, this is not the dynamic informants identified.

Rwandan exporters (private and cooperative-owned) look to NAEB rather than CEPAR for support. Rwandan private exporters were overwhelmingly positive about NAEB, with a large majority making directly positive statements. They also highlighted services provided by NAEB such as improving coffee quality, helping with export documents, advising on which farmers to buy from, helping with cupping, and planting coffee trees. One exporter (P2) said: “They do help a lot. They help with quality. They give us experts. They store our coffees. [There are] many ways to interact with them. And they do a beautiful job.” A small minority of Rwandan exporters had mild criticisms of NAEB, such as that they are not always able to help with cupping coffee, that they had reduced farmer extension support, and that they are not effectively marketing Rwandan coffee. Most cooperative representatives made positive statements about NAEB; none made negative statements.

In theory, CEPAR represents all export companies. However, some exporters suggested that they primarily represent large exporters. Both Rwandan and foreign exporters agree that CEPAR is ineffective in advocating for exporters' interests. Some Rwandan private exporters expressed positive sentiments about CEPAR, but a larger number were more negative, with some saying that CEPAR was ineffective at advocacy. One exporter (P9) had a nuanced view:

> CEPAR is a good idea. It was a good idea. But over the time it seems…Ok, it is helping, but it's not giving much, enough to its members. That's my own opinion. And I think they are good...but it requires thinking strategically and having some real ideas of kind of services to provide.

Contracting and value chain governance approaches to overcome challenges

This section discusses contracting and value chain governance approaches that exporters use or benefit to overcome challenges in contracting with suppliers: Relational contracts, vertical integration, contracts and pre-financing, and the zoning policy.

Relational contracts: Rwandan private and cooperative-owned exporters rely on trust and reputation in contracting, which lowers information costs. Evidence of use of relational contracts begins with how Rwandan exporters talked about relationships with farmers relative to how foreign exporters discussed this.

Rwandan exporters suggested relational or ethical reasons for providing services (e.g., training, transportation, etc.), with several saying they provided services because it is essentially the right thing to do. Others said that providing services motivates farmers. Some made statements about their general affection for farmers or noted the importance of communication with farmers. As a Rwandan exporter (P13) said:

> It's a family business. We want everyone involved to benefit. We want to give back what is fair. We know that farmers are not always getting the best price. We target a high-end specialty market. The buyers know the premiums we are paying.

Like private Rwandan exporters, cooperatives emphasized the importance of relationships with farmers, with several focusing on the importance of building a feeling of community for cooperative members. For Rwandan exporters, relationships with suppliers are important both to avoid suppliers reneging on agreements and also as a quality control mechanism. Local exporters face high information costs around coffee quality, so anything they can do to access information helps reduce these costs.

While foreign exporters also provide services, their motivations seem to be more transactional. While one MNC talked about the benefits of building long-term relationships, another implied that services provided are primarily aimed at preventing side-selling. Another foreign exporter (F5) said that "honestly I don't screw them [farmers] at all," but that ultimately exporters must protect their businesses. A third foreign exporter suggested that Rwandan CWSs and cooperatives cannot be trusted for cultural reasons and consistently renege on agreements.

Vertical integration: Foreign exporters are more vertically integrated than Rwandan exporters, with four foreign exporters vertically integrated from CWS up to the importer level and three owned by MNCs. To control quality and prices along the value chain, MNCs purchase CWSs and dry mills. Several foreign exporters said that a benefit of vertical integration is reduced risk, with some saying that benefits of vertical integration include quality control and better price information. One (F1) was blunt that vertical integration was the only way they could continue making money in the context of zoning and high farmgate prices:

> I know that NAEB [is] not encouraged by the idea of these international businesses continuing to buy washing stations and invest. They would rather see Rwandan washing station owners, as would I. That's where I think they don't believe what I'm saying… I would love to have no washing stations or sell the ones we have but…the regulatory framework is actually encouraging the international businesses to invest in washing stations. The very thing that we'd love to see less of.

Captive via formal contracts and pre-financing: An additional way that foreign exporters control quality and reduce risk is through a "captive" value chain governance approach via contracts and pre-financing (Gereffi et al., 2005). All foreign companies used contracts with CWSs and—unlike other exporters—most had taken suppliers to court for breaking contracts. Contracts are expensive to enforce and many Rwandan exporters may not be able to afford going to court, but some foreign exporters can.

Contracts, however, are not always effective in convincing suppliers to comply with agreements, and exporters said that some farmers and CWSs side-sold despite contracts. One noted that CWSs and farmers would take pre-financing, sell the coffee to one of their competitors, and then pay them back with the profits they made selling to their competitors. A foreign exporter (F1) with experience in Rwandan courts said:

> We had a lot of trouble in the first few years of operation, but the advice we got from other people in the industry was just let your contract, the institution and the legal trade markers there do its work… so we took a couple people to court who side-sold coffee who we warned and I guess word travels fast that we were serious and then so we haven't had that problem.

Punishments for reneging on contracts when pre-financing is involved can be severe. CWSs can go out of business or be rented to another company until they pay off their loan.

While they tend to rely on strong relationships with farmers, some Rwandan exporters use contracts with farmers, CWSs, or buyers. Several Rwandan private exporters that use contracts said that they reduce risk. Some said that contracting with farmers gets them better coffee and others said that it helps with traceability. Some Rwandan exporters also contract with buyers, and a minority said that contracting with buyers helps them get loans, because they can take contracts to the bank as evidence of a confirmed buyer. Rwandan exporters generally do not pre-finance

CWSs and do not often take farmers, CWSs, or buyers to court for reneging on agreements. While some cooperatives also saw contracts as reducing risk, this is less of a theme, perhaps because cooperatives are owned by their members, who are also their suppliers.

Captive via zoning: The zoning policy protects some Rwandan exporters from competition with foreign exporters, who can raise cherry prices or pay up-front when Rwandan exporters cannot. Since the zoning policy was implemented recently, the monopsony structure associated with it is still imperfect. Exporters claimed that side-selling still exists and that farmers do not face penalties for doing it. However, it is more difficult for farmers to side-sell without traders frequently visiting their farms. Zoning is positive for Rwandan private exporters that own CWSs, because it ensures that they will have cherry to purchase. It also may help exporters who do not own CWSs but purchase from specific CWSs, if the volume of coffee available is more predictable.

Several Rwandan private exporters were positive about zoning, saying that competition had decreased. A small number were mildly critical. Summarizing the benefits of zoning for local exporters, one respondent (P11) said:

> For us, for local farmers, for local companies, we are doing the zoning process, the zoning is protecting us, it has stabilized the competition, no high competition, as it did before, so we are appreciating the zones. The importance [is] to work properly with farmers, if you work properly with farmers, the zoning is there, if you don't work with those properly, they [farmers] will disappear to the competitors…

While there was less convergence for cooperatives, some were positive about zoning. Some said that CWSs are respecting zones and not raising prices and that zoning reduced competition. While a minority of cooperatives lost members because of zoning, this was not a major topic of discussion.

Table 3 summarizes contracting and value chain governance strategies employed by different types of exporters.

Table 3: Contracting and value chain governance approaches for coffee exporters

	Rwandan private	**Cooperative**	**Foreign**
Relational contracts	Core approach in relation to farmers/ CWSs; service provision, trust, monitoring for quality.	Core approach in relation to farmers/cooperative-owned CWSs; service provision, trust.	Not a core approach.
Vertical integration	Limited vertical integration; some CWS and dry mill ownership to control quality, costs.	Limited vertical integration; CWS ownership, some dry mill ownership to control quality, costs. Cooperative is owned by farmers, so arguably integrated from farm level.	Core approach to controlling quantity, quality, cost, and marketing. Can be integrated from CWS to foreign importers via global trading companies. Some use global traders for marketing and financial hedging.
Captive via pre-financing and contracts	Not a core approach.	Not a core approach.	Core approach in relation to CWSs via pre-financing and legal action in case of non-payment.
Captive via zoning	Core approach between CWSs and farmers via the zoning policy.	Core approach between CWSs and farmers via the zoning policy.	Generally, does not benefit foreign exporters because it limits their ability to purchase cherry.

Stakeholder perspectives on exporter approaches to overcoming challenges

Stakeholders discussed the role of NAEB and CEPAR in supporting exporters to overcome challenges, agreeing that Rwandan exporters tend to approach NAEB for support rather than CEPAR. Some also noted that CEPAR generally represents large exporters. One stakeholder, who was generally positive about CEPAR, said that CEPAR does not have enough resources or a sufficiently broad mandate to be effective.

Stakeholders did not speak in detail about contracting structures; however, when asked whether farmers preferred to sell to Rwandan or foreign-owned CWSs, some stakeholders responded that farmers generally sell to whoever has money up-front or pays better. This tends to be foreign exporters, but that is not always the case. Adding nuance to the idea of Rwandan companies using relational contracts, one stakeholder said that while Rwandan exporters may want to help farmers, they cannot provide high quality services because of limited resources.

2.6 Discussion and conclusions

This paper contributes to the scant literature on coffee exporters by describing their structures and the barriers they face. We find that Rwandan exporters and cooperatives faced numerous challenges, including (1) high competition for cherry because of incomplete implementation of the zoning policy; (2) difficulty in accessing financing because of perceptions of risk by banks, (3) hold up and fraud by suppliers, and in the case of private companies (4) high cherry prices, because of the farmgate price and competition for cherry. Both Rwandan private and cooperative-owned exporters were concerned about the effect of low global prices. By comparison, foreign companies largely pointed to government policies (e.g., farmgate price and zoning) as constraints, while also suggesting risks in dealing with local companies. While both Rwandan and foreign companies referenced high cherry prices as a problem, foreign exporters framed this as a problem of high farmgate prices whereas private Rwandan exporters expressed it as a combination of high cherry prices and low global prices.

This paper also describes contracting and value chain governance approaches to overcome challenges. In doing so, it pulls both from global value chain studies and New Institutional Economics concepts, an approach not commonly used (Ajwang, 2019). We find that Rwandan

private and cooperative-owned exporters have unique approaches to deal with transaction costs such as high information costs: relational contracts with farmers and CWSs, relationship with government, and use of the zoning policy to protect against competition for coffee cherry. Their reliance on relational contracts supports previous research on local firms in manufacturing and trading, including Rwandan CWSs (Fafchamps, 2004; Fafchamps & Minten, 1999; Macchiavello & Morjaria, 2015). Their reliance on relational contracts may in part be caused by their lack of resources that would allow them to vertically integrate, pre-finance, or litigate against trading partners who renege on agreements. Particularly when dealing with numerous smallholder farmers, using relational contracts involves building social capital over the long term, which takes substantial time and effort. Where they have difficulty is in dealing with foreign firms, which can hold them up or renege on agreements without fear of relational censure.

Foreign exporters are structurally different from local exporters and have different approaches to solving challenges. They are more vertically integrated—often owning CWSs and dry mills, have access to foreign markets, and may have less difficulty accessing financing. In addition, because of their resources, many pre-finance suppliers, thereby locking them into contracts. How foreign exporters deal with delays in payment and side-selling differs from Rwandan exporters—they are more likely to use the courts to settle disputes rather than working through relational contracts. Unlike Rwandan exporters, MNC exporters have another advantage: they can simply buy more coffee from other countries if the costs of exporting from Rwanda become too great. Their ability to diversify coffee buying gives them options that local exporters do not have.

Finally, while this study does not provide direct evidence on whether Rwanda's coffee sector is on a "treadmill," it does provide evidence that some common elements expected in a treadmill situation are observable. There is increasing consolidation by exporters in terms of volume of export and purchasing CWSs. While exporters and stakeholders suggested that NAEB has high organizational capacity, they said that CEPAR does not and some suggested that local value chain actors do not either. While some cooperative-owned exporters were involved in marketing coffee externally—a knowledge-intensive activity—local firms were less involved in this, with some selling to foreign exporters or a single foreign buyer. Low national coffee production, farm level productivity, and farmer incomes also suggest that despite increased sophistication of largely foreign-owned processing approaches, benefits of any "upgrading" process are not widespread (Clay et al., 2018). Finally, multiple foreign exporters noted that they can easily replace Rwandan coffee with substitutes from other countries, so it was difficult to justify high cherry prices. Thus, each item on Pipkin and Fuentes' list of indicators of value chain treadmilling—"high buyer dependence, low local institutional capacity… outsourcing of knowledge-intensive activities, and adoption of easily imitable upgrades"— is present in Rwanda's coffee sector (2017, p. 537).

Consolidation of the sector may allow MNCs to hold up farmers, CWSs, and ultimately the government in order to receive favorable prices and policies. Currently, Rwanda's government is not limiting MNCs' ability to vertically integrate, but is limiting competition for coffee cherry between CWSs and the exporters that own them through zoning. This, and high farmgate prices, makes it more profitable for MNCs to own CWSs because MNCs can access larger and more

predictable volumes of coffee and through vertical integration are better able control their costs at each stage of processing.

The government can take steps to strengthen Rwandan exporters or increase their bargaining power and, in turn, the share of income from coffee staying in Rwanda without directly limiting the ability of foreign exporters to invest. One approach would be to more forcefully designate CEPAR as an advocate for all export companies. For example, NAEB could require a certain proportion of CEPAR's board to be Rwandan-owned companies and make CEPAR the sole negotiating mouthpiece of exporters in Rwanda. Another approach would be to provide capacity building support to Rwandan exporters, for example in building up their capacity to market coffee to foreign buyers. If the government is concerned that benefits of value chain upgrading are accruing to MNCs rather than local firms, they could encourage knowledge-sharing or technology-sharing contracts between foreign exporters and local farmers, CWSs, and dry mills (Reardon, Barrett, Berdegué, & Swinnen, 2009).

In addition, implementation of policies that affect all exporters could help Rwandan exporters. For example, improving implementation of zoning to further reduce competition between CWSs for cherry would ameliorate a problem facing local exporters. Providing financial management capacity building for exporters may improve Rwandan exporters' ability to receive and effectively manage loans. Reducing the costs of legal action could lessen the incidence of fraud/ reneging (Macchiavello & Morjaria, 2015). Finally, much of what is driving financial challenges for all exporters is the difference between local farmgate prices and global prices. Reducing farmgate prices is not a helpful option; farmers are barely paid above the cost of production and paying them less will reduce farmer investment (Clay et al., 2018). However, the government

could put in place price stabilization mechanisms to protect the industry during periods of particularly low global prices.

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CHAPTER 3: DO GOVERNMENT MONOPSONY POLICIES IMPROVE BUYER-FARMER RELATIONSHIPS? EVIDENCE FROM RWANDA'S COFFEE SECTOR

3.1 Introduction

Can farmers benefit from losing the freedom of where to sell their produce? Some evidence suggests that national or regional monopsony systems may be able to improve relationships between farmers and buyers (Baumann, 2000; Minten, Randrianarison, & Swinnen, 2009; Sivramkrishna & Jyotishi, 2008; Sukhtankar, 2016). However, empirical evidence on different experiences with monopsony systems—in which farmers must sell to one buyer—is not definitive (Theriault & Tschirley, 2014). The institutions that connect farmers to buyers in developing countries are important to the functioning of markets and to farmers' ability to profit from their production. Contract farming, in which a buyer contracts with farmers to produce a good at agreed upon specifications to be sold at an agreed upon price, is important in connecting farmers to global markets and upgrading the quality and farmer price of produce (Barrett et al., 2012; Bellemare & Lim, 2018; Meemken & Bellemare, 2020; Ton, Vellema, Desiere, Weituschat, & Haese, 2018). However, attempts to contract in rural, developing country contexts often face quality, information, and contract enforcement problems (Barrett et al., 2012). This has led buyers and governments toward monopsonistic systems in which farmers must sell to specified buyers, and those buyers cannot compete with each other for produce (Baumann, 2000; Sivramkrishna & Jyotishi, 2008; Sukhtankar, 2016). One such approach is through local "zoning" systems in which governments provide buyers geographic areas where they can purchase produce without competition (Bassett, 2014; Poulton & Tschirley, 2009; Sukhtankar, 2016). While there is some evidence that monopsonistic purchasing structures can improve the functioning of contract farming and even benefit farmers in the context of market imperfections

such as high contract enforcement costs (Minten et al., 2009; Sivramkrishna & Jyotishi, 2008; Warning & Key, 2002), findings have been mixed on regional monopsony systems implemented by governments (Poulton & Tschirley, 2009; Sukhtankar, 2016; Theriault & Tschirley, 2014). A recent example of a regional zoning system is Rwanda's coffee sector – the focus of this paper. Most studies on zoning systems focus on West African cotton, where national monopsonies have given way to zoning systems (Bassett, 2014; Poulton & Tschirley, 2009; Theriault & Tschirley, 2014). Zoning has also been used in sugarcane in India (Sukhtankar, 2016). Rwanda's case is unique in that the country moved from a national monopsony prior to the 1994 genocide, to a competitive market through a series of reforms in the late 1990s and early 2000s, then to a monopsonistic zoning system in 2016 (Behuria, 2019; Boudreaux, 2011). The zoning system requires coffee farmers within geographic zones to sell to specific coffee washing stations and bans sales or purchases outside of zones (Gerard, Clay, & Lopez, 2017). Coffee washing stations (CWSs) are mills that purchase fresh coffee cherry, process it—removing skin and pulp—and then sell wet-processed coffee to exporters (Daviron & Ponte, 2005). The stated purpose of zoning is to improve relationships between farmers and buyers, eliminate the role of local traders in selling coffee, and improve traceability (National Agricultural Export Development Board, 2016). Prior to zoning, coffee washing stations (CWSs) used relational contracts and provision of services to attract farmers (Macchiavello & Morjaria, 2019). Local traders purchased fresh coffee from numerous farmers and then sold the coffee to CWSs, including to competitors of those CWSs that had provided services to farmers with the understanding that the farmers would deliver them fresh coffee at harvest in return (Macchiavello & Morjaria, 2019). This led to the

breakdown of relational contracts and a reduction in service provision by CWSs (Macchiavello & Morjaria, 2019).

What are the effects of a zoning policy such as exists in Rwanda on how buyers treat farmers? Do they provide higher quality services than in the past to motivate farmer production and/or because they are confident that farmers will not renege on agreements? Or do they exploit farmers who now lack other sale options? We test the hypothesis that zoning encourages buyers (CWSs) provide second payments to farmers because (1) CWSs are no longer faced with a high risk of farmers side-selling,[3] and (2) because CWSs are assigned a set number of farmers and lack other sources of fresh coffee, and thus will want to motivate farmer production. This hypothesis is based on previous studies that suggest that monopsony buying can be mutually beneficial to farmers and buyers in contexts with high costs of contract enforcement, as is the case in Rwanda (Key & Runsten, 1999; Maertens, Colen, & Swinnen, 2011; Minten et al., 2009; Sukhtankar, 2016; Theriault & Tschirley, 2014).

This study uses a mixed methods approach, including a difference-in-differences (DD) analysis of farmer survey data as well as key informant interviews with CWS managers and government representatives, to provide evidence about the effectiveness of a local monopsony policy for contracting between farmers and buyers. This study is unique geographically and in terms of value chain – most other studies have focused on West African cotton, with some study of sugarcane in India. It is also unique in that—rather than liberalizing from a national monopsony to a local monopsony as was the case in Burkina Faso and Mozambique—Rwanda moved from a competitive market to a local monopsony (Theriault & Tschirley, 2014). Finally, this case

3 Side-selling is when producers divert produce from the buyer with whom they had a written or verbal agreement. This practice is widespread in agricultural markets where contract enforcement is difficult, and is a particular problem in the coffee industries of Rwanda and Burundi (Gerard, Lopez, Clay, & Ortega, 2020; Macchiavello & Morjaria, 2019).

describes a unique form of monopsony in which farmers do not face penalties for side-selling but in which local traders and CWSs are punished for purchasing coffee from outside of their zones. We find that, on average, Rwanda's zoning policy increased the promise and provision of "second payment" bonuses for farmers who were more affected by the policy relative to farmers who were less affected. We use awareness of the policy as a proxy for a minimum level of policy implementation. We also find that farmers in Huye district, where zoning implementation was weakest, were less likely than other farmers to be promised or receive second payments after zoning was implemented. Key informant interviews suggest that private CWS owners were motivated by the policy change to improve service provision to farmers.

3.2 Literature review

Contract farming has the potential to improve smallholder farmer incomes by connecting smallholders to global buyers (Barrett et al., 2012; Bellemare, 2018; Meemken & Bellemare, 2020; Ton et al., 2018). Bellemare and Lim (2018) suggest several potential benefits of contract farming, including reducing risk for farmers and buyers, reducing financial and transaction costs, overcoming missing markets for information and credit, improving product quality, and improving farmer welfare.

However, contracts in rural settings in developing countries are often verbal and can be difficult to enforce, with substantial farmer side-selling, hold up, and other problems causing contracts to fail (Barrett et al., 2012; Grosh, 1994; Macchiavello & Morjaria, 2019). Some authors suggest that for contract farming to work in this context, buyers must have a monopsony (Baumann, 2000; Oya, 2012).

Monopsonies can be economically inefficient because the monopsonist will generally pay suppliers less than suppliers would receive in a competitive market and there will be deadweight loss (Sivramkrishna & Jyotishi, 2008). Some scholars studying contract farming have expressed concern about the potential for exploitation of farmers under monopsonistic contract farming systems (Porter & Phillips-Howard, 1997; Sivramkrishna & Jyotishi, 2008; White, 1997). Some authors are particularly concerned about situations in which the monopsonist pays all suppliers a low rate for produce (Sivramkrishna & Jyotishi, 2008). It is also possible that, because farmers do not have alternative sale channel options, buyers may hold them up by refusing to pay for produce or paying a lower price than agreed upon (Barrett et al., 2012; Cungu, Gow, Swinnen, & Vranken, 2008).

However, some evidence suggests that in contexts with market imperfections such as high enforcement costs, high information costs, and asset specificity, monopsonistic contracting can form mutually beneficial relationships that gives both sellers and buyers greater certainty about prices, quality, and volume (Baumann, 2000). In Madagascar, Minten, Randrianarison and Swinnen (2009) describe how a monopsonistic foreign buyer provided bundles of inputs on credit to smallholders and purchased their produce that met export standards. The authors found that the buyer paid prices substantially above local market prices, and farmers benefited financially (Minten et al., 2009). There are other examples wherein buyers provided higher prices than local markets to make up for farmers' lack of sale channel choice (Warning & Key, 2002) and in which buyers provided inputs or other services to increase the supply of produce (Sivramkrishna & Jyotishi, 2008).

An important difference between monopsony buying as discussed by much of the contract farming literature and Rwanda's zoning policy is that zoning is a government-mandated program in which farmers do not have a choice whether to enter into contracts with a buyer—the local government tells them to whom they must sell. In addition, under zoning, while farmers are not penalized for side-selling, local traders and CWSs are penalized for buying outside of their zones. By comparison, in some contract farming examples the primary punishment for breaking a contract would be being excluded from future business with that buyer (Minten et al., 2009). Rwanda's zoning system is most reminiscent of regional cotton monopsonies in parts of West Africa (Bassett, 2014; Poulton & Tschirley, 2009; Theriault & Tschirley, 2014). Poulton and Tschirley describe "local monopolies," in which governments give concessions for specific regions to cotton buyers (2009). These monopsony systems often come from reforms of national monopsony systems (Theriault & Tschirley, 2014). In some cases local monopolies have been effective at distributing inputs and providing credit; however, there is substantial variation in success based on institutional differences (Theriault & Tschirley, 2014). Sukhtankar (2016) describes a similar zoning policy in sugarcane in the Indian state of Tamil Nadu, where the government put in place a relatively high floor price for farmers to protect them from exploitation. Sukhtankar does not find evidence of buyer hold up of farmers.

3.3 Rwandan context

In Rwanda, *arabica* coffee is grown by numerous smallholder farmers who sell fresh coffee "cherry" to CWSs. Most coffee in Rwanda goes through CWSs because farmers grow coffee on small plantations and do not have the capacity to process high-quality coffee at their homes. After purchasing coffee from CWSs, exporters hull the coffee at dry mills, then ship it to Kenya

for export. Since 2000, over 250 CWSs have been built in Rwanda by government, donors, and the private sector (Clay, Bro, Church, Ortega, & Bizoza, 2018; Murekezi, Jin, & Loveridge, 2012).

Coffee cherry must be delivered to CWSs within six hours of harvest, or else the cherry spoils (Clay et al., 2018). Thus, farmers' ability to access CWSs or local traders quickly is critical to the functioning of the value chain. Farmers sell their coffee to privately owned CWSs, to CWSs owned by farmer cooperatives, or to local traders who then sell to CWSs (though, as discussed in section 3.3.2, this last option is less common under zoning). As of 2017, just under half of Rwanda's CWSs were owned by cooperatives (AgriLogic, 2018).

3.3.1 Rationale for and implementation of zoning

The rationale for zoning in Rwanda is based in part on the breakdown of relational contracts due to increased CWS competition, which itself relates to the liberalization of Rwanda's coffee sector in recent decades. Prior to the 1994 genocide, Rwanda's government purchased and sold all coffee through a national marketing board, with price stabilization mechanisms and government distribution of inputs (Behuria, 2019). Following the genocide, the coffee sector began liberalizing, and local and foreign exporters entered the sector (Behuria, 2019).

During the period following liberalization, relational contracts formed between CWSs and farmers, allowing for effective cooperation in production and marketing despite the high costs of enforcing contracts. In relational contracts, actors use reputation, relationships, and reciprocity to contract when enforcement costs are high (Banerjee & Duflo, 2000; Fafchamps & Minten, 1999). According to Macchiavello and Morjaria (2019), prior to 2016, Rwandan CWSs and farmers had relational contracts in which some CWSs provided inputs and/or credit at the

beginning of the season. Farmers sold coffee to CWSs for below the coffee's full value, which was helpful to CWSs with limited liquidity. Then, upon selling processed coffee to exporters, CWSs would provide a "second payment" to farmers out of the sale price (Macchiavello & Morjaria, 2019; Mujawamariya, D'Haese, & Speelman, 2013). As the number of CWSs increased, competition between CWSs and side-selling by farmers reduced CWSs' willingness to extend inputs, credit, and second payments to farmers (Macchiavello & Morjaria, 2019). Rwanda's 2016 zoning policy was designed to improve relationships between CWSs and farmers, improve traceability, and eliminate local traders from the coffee sector (National Agricultural Export Development Board, 2016). Zoning requires farmers to sell to specific CWSs, and requires that a given CWS purchase coffee from farmers within its zone (Gerard et al., 2017). With zoning, it became illegal for local traders to purchase coffee and take it out of zones (Gerard et al., 2017).

Zoning is implemented by the National Agricultural Export Development Board (NAEB), which oversees Rwanda's coffee industry (National Agricultural Export Development Board, 2016, 2019). NAEB told district-level governments in coffee producing areas to create committees to design zones (Africa Great Lakes Region Coffee Support Program, 2017). These District Task Forces designed zones based on a 2015 coffee tree census, which provided information on the number of productive coffee trees available within a district (Gerard et al., 2017). In interviews conducted with managers of CWSs for this study, the number of farmers in their zones ranged from 330-2,500 and averaged 1,315[4]. The number of farmers associated with a zone is based on the number of trees that farmers have and the operating capacity of the CWS. In many cases, zoning meant that farmers had to sell to a different CWS than the one they commonly sold to

4 Based on 14 respondents. Two CWS managers did not know how many farmers were in their zones.

prior to zoning. For example, many farmers who were cooperative members and who had been trained or certified (e.g., as organic or Fair Trade) by their cooperative-owned CWSs were moved to other CWSs and were unable to benefit from cooperative membership or certification (Gerard et al., 2017).

The Rwandan government attempts to limit the ability of buyers to financially exploit farmers by setting a minimum price, commonly known as the "farmgate price," based on estimated farmer costs of production and global coffee prices (Clay et al., 2018; Ntirenganya, 2019). While the farmgate price served as a floor price prior to zoning, after implementing zoning, Rwanda's government encouraged CWSs to pay exactly the farmgate price, with any bonuses to be paid as second payments (Africa Great Lakes Region Coffee Support Program, 2017; Gerard, Lopez, Kerr, & Bizoza, 2020). This was intended to decrease price competition at the CWS level, which could drive farmer side-selling and break the zones (Gerard, Lopez, Kerr, et al., 2020).

Evidence suggests that zoning varied in its structure and enforcement when initially implemented. Districts implemented the policy differently (Gerard et al., 2017) and in 2018 coffee exporters suggested that there was still rampant side-selling and high competition for cherry in areas with high concentrations of CWSs (Gerard, Lopez, Kerr, et al., 2020). Coffee exporters also suggested that farmers were not penalized for side-selling, while acknowledging that there had been a reduction in traders moving across zones (Gerard, Lopez, Kerr, et al., 2020).

Zoning was widely disliked both by farmers and cooperative-owned CWSs when first implemented (Gerard et al., 2017). In 2016, 76 percent of farmers surveyed believed that zoning would not benefit farmers like them and cooperative representatives complained that members

were no longer allowed to sell cherry to them (Gerard et al., 2017). Farmer perspectives had changed by 2017, with 61 percent of farmers saying that zoning benefited farmers like them (Africa Great Lakes Region Coffee Support Program, 2018). This may be a result of the relatively high farmgate price in 2017, but it is also possible that by 2017, CWSs had adapted to zoning and were providing better services including potentially more or larger second payments. Consistent with this hypothesis, interviews with CWS managers for this study indicate that many CWS managers viewed the zoning policy positively in 2019, and other research suggests that many Rwandan exporters believed zoning was helpful for reducing CWS competition (Gerard, Lopez, Kerr, et al., 2020).

3.4 Methods

3.4.1 Mixed methods approach

We use a difference-in-differences (DD) analysis of farmer survey data to identify the effect of zoning on CWS provision of second payments. We triangulate quantitative findings with key informant interviews with CWS managers to understand the effects of zoning on second payments and provision of other services, as well as how zoning was implemented in their areas. In addition, we use interviews with government representatives to understand the dynamics of zoning implementation in the sampled districts.

We use a nested mixed methods approach (Lieberman, 2005) – the quantitative analysis serves as a foundation, and qualitative data collection is used to fill in gaps. Data from the farmer survey was analyzed first and was used to create CWS manager and government representative interview protocols.

3.4.2 Data

Survey data

Survey data used in this study come from coffee farmer household surveys conducted in 2015, 2016, and 2017. The farmer survey was conducted in four coffee-producing districts spread across Rwanda – one representing each quadrant of the country: Gakenke (Northern Province), Huye (Southern Province), Kirehe (Eastern Province), and Rutsiro (Western Province).[5] We purposively sampled four CWSs (two cooperative owned and two privately owned) in each district (16 CWSs total) to achieve a degree of geographical dispersion and ensure we had equal representation of cooperative and private CWSs. We used a systematic random sampling approach, sampling 64 farming households from each CWS registry for a full sample of 1,024 households (16 CWSs X 64 households). The survey instrument included topics such as farmer investment and productivity, household demographics, farm agroecology, services received from buyers, and related topics.

We conducted a baseline survey of these 1,024 households in 2015 and a random sample of half of these households (512) in 2016, followed by an endline survey with this same 512-farmer sample in 2017. The smaller sample used in 2016 and 2017 was due to budgetary constraints. Because zoning was first implemented in 2016 (and continues to the present), using the 2015 and 2017 surveys gives us pre- and post-implementation data.

5 Rwanda is organized into 30 districts within five provinces: Northern, Southern, Eastern, Western, and Kigali City.

Interview data

The managers of each of the 16 CWSs included in the farmer survey sample were interviewed in 2019. We developed a protocol focused on zoning, with questions on CWS relationships with farmers, including services provided.

In addition to interviews with CWS managers, in 2019 we also interviewed four government representatives familiar with how zoning was implemented in the four districts included in the farmer survey. This interview protocol focused on implementation structures and timeline, outreach conducted about zoning, and penalties for breaking zones, among other questions.

All interviews were conducted in Kinyarwanda by a Rwandan research assistant and translated into English. Interviews were conducted in-person and were recorded, then transcribed for analysis.

3.4.3 Analytic approach

Regression analysis

A DD approach is used to compare the likelihood of being promised or receiving a second payment between 2015 and 2017 based on whether farmers knew about the zoning policy. DD is a quasi-experimental approach that allows us to compare changes in outcomes between groups that are and are not affected (or are differentially affected) by a policy change due to the design or implementation of that policy change (Gertler, Martinez, Premand, Rawlings, & Vermeersch, 2016). It does this by comparing the before versus after conditions for the treatment group to the before versus after conditions for the comparison group (Gertler et al., 2016). In this paper, DD analysis allows us to compare the effect of zoning on a group of farmers that we believe was more impacted by zoning than other farmers (in this case, farmers who knew about the zoning)

by using data from before and after zoning was implemented. We estimate the following equation:

(1) $y_{it} = \alpha + \gamma Treat_i + \lambda 2017_t + \delta(Treat_i \times 2017_t) + \varepsilon_{it}$

where i indexes the farmer; t indexes the year (t=2015, 2017); y is the outcome variable (receiving or being promised a second payment, discussed further below); and $Treat_i$ is an indicator variable equal to one if the farmer is aware of zoning, and equal to zero otherwise. As discussed further below, awareness of zoning is used as a proxy for a minimum level of zoning implementation. 2017_t is an indicator variable equal to one for survey year 2017, and equal to zero for survey year 2015. ε_{it} is the idiosyncratic error term. The key parameter of interest is δ, the DD estimate of the effect of zoning implementation (as proxied by awareness of zoning) on second payments promised/received. We discuss the estimation of equation 1 on page 63.

The dependent variable focuses on second payments because one of the effects of the breakdown of relational contracts prior to zoning was that farmers were less likely to receive second payments (Macchiavello & Morjaria, 2019). If zoning improves relationships between farmers and CWSs, we might expect to see a greater proportion of farmers receiving second payments. However, if CWSs are exploiting farmers, they would be unlikely to pay farmers a dividend at the end of the season based on CWS profits. Evidence from CWS interviews also suggests that NAEB encouraged CWSs to provide second payments as part of zoning implementation.

Our measure of second payments includes second payments received by farmers as well as second payments promised but not yet received at the time of the survey. The reason to include second payments promised is that the 2017 survey was conducted in October, before most second payments were delivered to farmers. According to farmers and CWS managers, second

payments are generally distributed between November and January. By comparison, the 2015 baseline was conducted in December, when most but not all second payments had been delivered. We created a binary variable for "second payments promised or received" for 2015 and 2017 in which 1 = promised and/or received a second payment, and 0 = not promised a second payment and did not receive a second payment.

We may be concerned that CWSs might promise second payments but not deliver them. While this is a risk in the 2017 survey, it would also be a risk in the 2015 survey. In addition, evidence from the 2015 survey suggests that a large percentage of farmers who were promised second payments did in fact receive them. Based on the 2015 survey, which was conducted late enough that most second payments had been processed (December 2015), 69.1 percent of farmers who had been promised a second payment had already received it. By comparison, in the 2017 survey (conducted in October) 33.7 percent of farmers who had been promised a second payment had received it. It is likely that the percentage receiving second payments would increase until all second payments were processed, which is generally in January. Finally, the act of promising a second payment is a gesture of goodwill by the CWS, which itself may indicate an improved relationship even if not all CWSs were able to deliver the second payments they promised.

As noted above, $Treat_i$ is farmer awareness of zoning, which serves as a proxy for a minimum level of policy implementation. In the 2017 survey, we asked farmers, "Have you heard of zoning as it relates to coffee cherry sales?" and coded responses yes = 1 and no = 0. We did not explain what the policy was before asking the question.

The zoning policy's success hinges on: (i) farmers knowing that they are supposed to sell to a specific CWS, and (ii) CWSs purchasing coffee solely from farmers inside their zones.

According to government representatives, NAEB conducted outreach to districts, and district governments conducted outreach locally. We suggest that farmer awareness of zoning is necessary but not sufficient for effective zoning implementation. This is because, even for farmers who did not need to change CWSs, it was important that they knew where they could sell coffee following policy implementation.[6]

Zoning has been implemented in a decentralized way, with district-level task forces setting zones and enforcing penalties on CWSs and traders that break zones (Gerard et al., 2017). Perhaps because of a diversity of approaches to implementation across districts or difficulty in reaching all farmers, many farmers did not know about zoning. In the 2016 farmer survey (conducted after the first season of zoning), 53 percent of farmers had heard of zoning, compared to 67 percent in the 2017 survey. This is a large increase, but insofar as it is a policy that should affect *all* farmers' behavior, it is not a well-known policy change.

Another reason to believe that awareness of zoning is a good proxy for implementation is the connection between regional differences in implementation, and differences in farmer awareness of the policy. Evidence from previous studies and from interviews conducted for this study suggests that, initially, zoning was not fully implemented in Huye or Kirehe districts (Gerard et al., 2017). For example, all four CWS managers interviewed in Huye in 2019 said that zoning was not fully implemented initially, with two saying that it came fully into effect in 2018.

In the 2017 survey, most farmers who had not heard of zoning lived in Huye and Kirehe: 61.3 percent of such farmers lived in Huye and 19.1 percent lived in Kirehe. By comparison, 8.9

6 Another approach would be to analyze the effect of zoning on the minority of farmers who moved CWSs between 2015 and 2017 versus those who did not, with the assumption that farmers who moved CWSs did so because of zoning. While an important group, farmers who moved CWSs are atypical; in our sample just 19 percent of farmers moved CWSs between 2015 and 2017. The effect of zoning felt by most farmers would not be moving CWSs, but would instead be losing access to local traders who would visit their farms to purchase coffee.

percent of such farmers lived in Gakenke and 10.7 percent lived in Rutsiro – two districts where zoning was more aggressively implemented. Our proposition based on qualitative data is that the level of local implementation and enforcement is highly positively correlated with awareness of the zoning policy and, as such, awareness of zoning can be used as a proxy for a minimum level of zoning implementation.

Government representatives interviewed did not indicate that there were intentional differences in implementation by district, but blamed a lack of understanding of zoning on the part of farmers and CWSs for high levels of side-selling. We do not believe this undercuts the use of awareness of zoning as a proxy for strength of implementation. Even if there were not intentional differences in the structure of zoning based on geography, it appears based on CWS manager perspectives, farmer awareness of the policy, and previous studies that there were variations in implementation (Gerard, Lopez, Kerr, et al., 2020).

In measuring the effects of a broad policy on specific groups that are more or less affected by it, this study is similar to an approach used by Qian (2008) to study the effects of prices for gendered crops on sex imbalances in China. More specifically, Qian used a DD approach to evaluate the effect of policies that raised prices for a female crop (tea) on the ratio of girls to boys, comparing areas that produced tea with areas that did not produce tea before and after policy reforms. This is similar to our approach in that it used a national policy, but one that affected different types of farmers differently.

Difference-in-differences assumptions and estimation

An important consideration in using a DD approach is the potential that treatment and control groups have different trend slopes on the outcome variable that would exist regardless of the

independent variable of interest (Gertler et al., 2016). The parallel trends assumption, which is required for identification in the DD context, states that this is not the case (Gertler et al., 2016). In cases like ours where there is a single pre-intervention data point, it is not possible to show that the parallel trends assumption held prior to the policy change. However, running DD regressions with placebo dependent and independent variables can be used to test whether the effects seen in DD regressions could be related to other trends (Gertler et al., 2016). If other, unrelated variables can act as a treatment or can be acted on by the treatment, this may indicate a problem. We ran several placebo tests, and in none of these cases found evidence of other unrelated trends. See section 3.5.3 for these tests.

To identify potential differences that might influence being promised or receiving second payments, we describe the two groups of farmers in Table 4. As can be seen in Table 4, there is no statistically significant difference in the share of farmers that were promised or received a second payment in 2015 (prior to zoning) between farmers who eventually were vs. were not aware of zoning in 2017. However, there are several 2015 characteristics that significantly differ between the two groups. Farmers that had heard of zoning in 2017 were more likely to be in male-headed households, to be literate, and to be cooperative members compared to farmers that had not heard of zoning in 2017. Farmers who knew about zoning in 2017 had more coffee trees and were located at higher elevations, which correlates with coffee quality. In addition, most farmers in Gakenke, Rutsiro, and Kirehe knew about zoning in 2017, whereas most farmers in the Huye district did not know about zoning. In the DD regression, we control for variables that differ between the two groups of farmers. In addition, we estimate a regression aimed at

identifying the potential effect of being in Huye district in 2017 on being promised or receiving second payments.

Table 4: Baseline (2015) differences between farmers who know vs. do not know what zoning is in 2017

Baseline (2015) values	Full sample (N=512)	Heard of zoning in 2017?	
		Yes (N=344)	No (N=186)
Received or promised a second payment (=1)		0.381	0.387
Male-headed HH (=1)		0.849*	0.756
Age of the HH head (years)		50.1	52.7
HH head is literate (can read and write) (=1)		0.712*	0.607
HH size (number of members)		5.4	5.3
HH is a member of a coffee cooperative (=1)		0.596**	0.464
Average elevation (m)		1,695.9**	1,738.6
Number of coffee trees		998.4*	668.3
District: Gakenke (=1)		0.883***	0.117
District: Huye (=1)		0.195***	0.805
District: Kirehe (=1)		0.750**	0.250
District: Rutsiro (=1)		0.859***	0.141

Notes: Values reported are means. HH=household. * indicates level of significance for t-tests of the null hypothesis that the means of the two groups are equal versus a two-sided alternative hypothesis.
* Significance at the 5% level
** Significance at the 1% level
*** Significance at the 0.5% level

Estimation strategy

Given these differences in baseline characteristics, in addition to estimating the basic DD specification in equation (1), we also estimate a specification in which we control for a vector of farmer, household, and coffee farm characteristics as of 2015 ($\boldsymbol{X}_{i,\,2015}$):

$$(2) \qquad y_{it} = \alpha + \gamma Treat_i + \lambda 2017_t + \delta(Treat_i \times 2017_t) + \boldsymbol{X}_{i,\,2015}\boldsymbol{\beta} + \varepsilon_{it}$$

$\boldsymbol{X}_i$ includes baseline demographic variables that may influence awareness of policy changes such as if the household head is literate, his/her age and sex, and household size as of the 2015

baseline. $\boldsymbol{X}_i$ also includes elevation, which influences coffee quality (and could thus affect receipt of second payments), with higher elevations generally producing higher quality coffee. In addition, Rwandan coffee cooperative members are more likely to receive services from their CWSs than non-cooperative members (Ortega et al., 2019); we therefore include a dummy for cooperative membership in $\boldsymbol{X}$. We also include the number of trees, as this relates to the volume of coffee produced. Larger-scale farmers may be more professional and, as can be seen in Table 4, may have more information about policies such as zoning. Finally, we include indicator variables for districts to control for district-specific, time-constant effects.

We cluster standard errors at the CWS level because clustered farmer sampling was conducted from 16 CWSs (Abadie, Athey, Imbens, & Wooldridge, 2017). Because of the relatively small number of clusters, cluster-robust standard errors can produce inaccurate t-tests (MacKinnon & Webb, 2018). We use a Wild Cluster Bootstrap approach, which has been shown to effectively deal with over-rejection of the null because of a small number of clusters (MacKinnon & Webb, 2018; Roodman, MacKinnon, Nielsen, & Webb, 2019).

An alternative, and potentially superior, approach would have been to cluster standard errors at the district level, since that is where policy implementation differences have been observed. However, four clusters is too few to cluster standard errors, and Wild Cluster Bootstrap does not work with such a small number of clusters (Cameron, Gelbach, & Miller, 2008).

3.4.4 Qualitative analysis of CWS interviews and interviews with government officials

Qualitative analysis focused primarily on the 16 CWS manager interviews. Answers provided by CWS managers were largely in a binary or scaled format rather than open-ended. We used count analysis for quantitative or binary answers. For open-ended answers we categorized key themes

using the text of the interview instrument and emergent elements from interviews (Saldana, 2016).

Interviews with government officials were primarily used to understand the dynamics of zoning implementation in the different districts. We used the interviews to understand how information was shared about zoning, whether there were intentional geographic differences in implementation, and whether there were punishments for violating zoning, among other dynamics of the policy.

3.5 Results

3.5.1 Difference in difference regression results

The DD regression results are reported in Table 5. Columns 1 and 2 show the results from the DD regressions without and with baseline controls, respectively. Districts are included as control variables, with Huye district as the omitted district. The key result of interest (the DD effect of the policy change) is the coefficient on the interaction term (HH head has heard of zoning X Year 2017).

Table 5: Difference in differences results (dependent variable =1 if 2nd payment promised or received, =0 otherwise)

Explanatory variables	(1)	(2)
HH head has heard of zoning (=1)	-0.006	0.008
	(0.051)	(0.043)
	[-0.112, 0.104]	[-0.085, 0.113]
Year 2017 (=1)	0.226***	0.226***
	(0.048)	(0.048)
	[0.135, 0.370]	[0.128, 0.368]
HH head has heard of zoning X Year 2017	0.131**	0.131**
	(0.035)	(0.035)
	[0.059, 0.200]	[0.055, 0.206]
Baseline (2015) covariates:		
Male-headed HH (=1)		-0.060
		(0.035)
		[-0.136, 0.017]
Age of the HH head (years)		-0.002
		(0.001)
		[-0.004, 0.000]
HH head can read and write (=1)		0.023
		(0.038)
		[-0.059, 0.113]
HH size (number of members)		0.015*
		(0.007)
		[0.001, 0.030]
Average elevation (m)		0.000
		(0.000)
		[-0.000, 0.001]
HH is member of a coffee cooperative (=1)		0.200***
		(0.038)
		[0.103, 0.280]
Number of coffee trees		0.000
		(0.000)
		[-0.000, 0.000]
Kirehe district (=1)		-0.231**
		(0.078)
		[-0.446, -0.056]
Gakenke district (=1)		-0.058
		(0.053)
		[-0.171, 0.077]
Rutsiro district (=1)		-0.031

Table 5 (cont'd)

		(0.079)
		[-0.227, 0.160]
Constant	0.387***	0.081
	(0.060)	(0.222)
Observations	1,024	1,024
R-squared	0.107	0.214

Notes: OLS regression. Standard errors clustered at the CWS level are in parentheses below coefficients. 95% confidence intervals from wild cluster bootstrap are in brackets. Huye is the omitted district.
* Significance at the 5% level
** Significance at the 1% level
*** Significance at the 0.5% level

We find that the probability of being promised or receiving a second payment in 2017 was 13.1 percentage points greater for farmers who had heard of zoning in 2017 compared to farmers had not. This effect is both statistically and economically significant, and robust to the inclusion of baseline controls. The magnitude of the effect of being in the treatment group in 2017 (using the Column 2 results) is 13.9 percentage points (0.008 + 0.131 = 0.139). Given that the 2015 baseline for "treated" farmers (those who had heard of zoning in 2017) being promised or receiving second payments was 38.1 percent, this is a 36.5 percent increase in the odds of being promised or receiving a second payment. This is a large effect and suggests that—all else equal—farmers who had heard of zoning were meaningfully more likely to be promised or receive second payments in 2017.

3.5.2 Additional evidence of geographic influences on second payments

Another way of testing the hypothesis that the level of zoning implementation in parts of Rwanda influenced CWSs' provision of second payments (and, in turn, farmers' receipt of such payments or promises thereof) is to use geographic variables in regressions. In table 6 we use a farmer's presence in Huye district rather than their awareness of zoning as the "treatment".

As noted, Huye had the lowest percentage of farmers who had heard of zoning in 2017, and CWS managers said that zoning had not been fully implemented there as of 2017. Descriptive data, such as that summarized in Figure Error: Reference source not found, show that while the percentage of farmers being promised or receiving second payments was higher in all districts in 2017 compared to 2015 (pre-zoning), the increase was smallest in Huye.

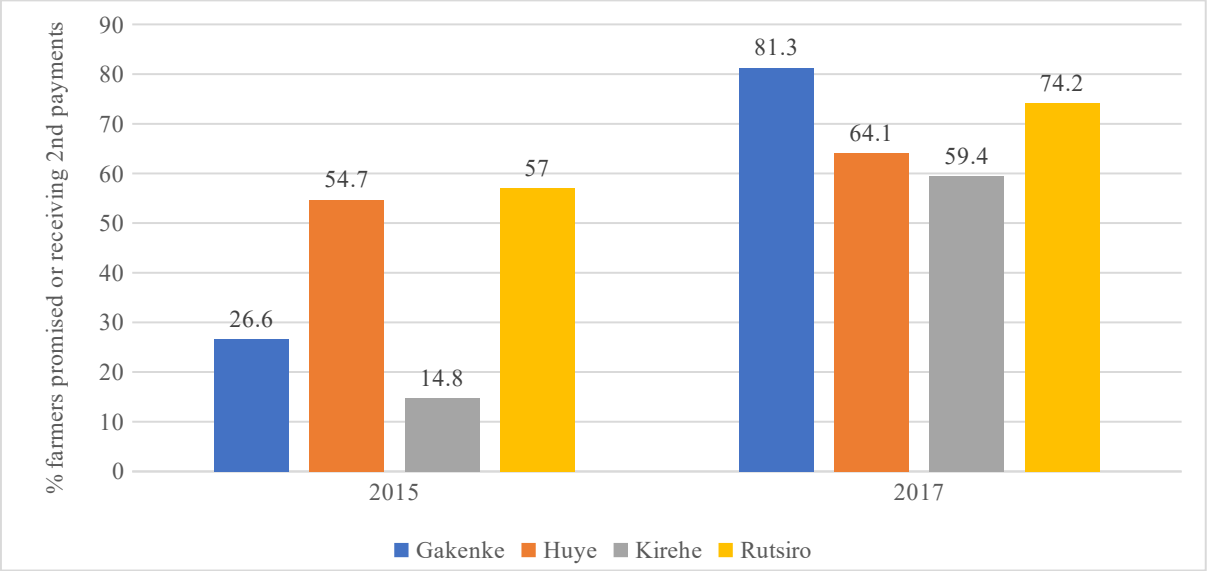

Figure 2: Percent of farmers promised or receiving second payments, by district and year

Table 6 presents results from a DD-like regression in which being in Huye is used as the treatment variable, and the coefficient of interest is the one on the interaction of being in Huye and the 2017 year dummy. Consistent with our hypothesis, we find that being in Huye in 2017 is associated with a 29.4 percentage point reduction in the likelihood of receiving or being promised a second payment (Column 1). This result is robust to the inclusion of additional district dummies and baseline controls (Column 2). These findings and those in Table 5 are consistent with the hypothesis that greater implementation of zoning is positively associated with farmers receiving or being promised second payments.

Table 6: Regression with Huye district as treatment (dependent variable =1 if 2nd payment romosed or received, =0 otherwise

Explanatory variables	(1)	(2)
Huye district (=1)	0.219*	0.133
	(0.089)	(0.083)
	[-0.008, 0.451]	[-0.095, 0.331]
Year 2017 (=1)	0.388***	0.388***
	(0.060)	(0.061)
	[0.257, 0.518]	[0.262, 0.518]
Huye district X Year 2017	-0.294**	-0.294**
	(0.077)	(0.077)
	[-0.482, -0.111]	[-0.492, -0.110]
Baseline (2015) covariates:		
Male-headed HH (=1)		-0.054
		(0.035)
		[-0.132, 0.024]
Age of the HH head (years)		-0.002*
		(0.001)
		[-0.004, 0.000]
HH head can read and write (=1)		0.023
		(0.037)
		[-0.055, 0.109]
HH size (number of members)		0.014
		(0.007)
		[0.000, 0.029]
Average elevation (m)		0.000
		(0.000)
		[-0.000, 0.001]
HH is member of a coffee cooperative (=1)		0.209***
		(0.036)
		[0.120, 0.285]
Number of coffee trees		0.000
		(0.000)
		[-0.000, 0.000]
Gakenke district (=1)		-0.020
		(0.075)
		[-0.181, 0.174]
Kirehe district (=1)		-0.208*
		(0.075)
		[-0.413, -0.024]
Constant	0.328***	0.041
	(0.063)	(0.176)

Table 6 (cont'd)

Observations	1,024	1,024
R-squared	0.120	0.223

Notes: OLS regression. Standard errors clustered at the CWS level are in parentheses below coefficients. 95% confidence intervals from wild cluster bootstrap are in brackets. Rutsiro is the omitted district.
* Significance at the 5% level
** Significance at the 1% level
*** Significance at the 0.5% level

3.5.3 Placebo tests

Placebo treatments and placebo outcome variables can be used to probe the parallel trends hypothesis. A placebo treatment can be used to test for the presence of other variables not caused by the treatment that may be influencing the outcome variable (Gertler et al., 2016). A null result can provide evidence to support the parallel trends assumption, but cannot prove that the assumption is valid. We used two placebo treatment groups, both based on farmer characteristics that are unrelated to awareness of zoning. The first (second) placebo group is farmers who grew maize (bananas) compared to farmers who did not grow maize (bananas). In the sample 61.7 percent of farmers grew maize and 55.3 percent grew bananas. There is a 0.11 correlation between growing banana and growing maize. The placebo treatment group regression tests whether growing maize or banana predicts being promised or receiving a second payment in 2017.

Table 7 presents results from the two placebo treatment tests. Model 1 uses growing maize as the treatment condition. Model 2 uses growing banana as the treatment condition. Similar to the previous DD regressions, the coefficient of interest is the one on the interaction between the placebo treatment group and the 2017 year dummy. This interaction effect is not statistically

significant in either case (maize and bananas), suggesting that the outcome variables are not being influenced by these seemingly unrelated treatments.

Table 7: Placebo treatments - difference in differences results (dependent variable =1 if 2nd payment promised or received, =0 otherwise)

Explanatory variables	Model 1	Model 2
HH grows maize (=1)	-0.028	
	(0.045)	
	[-0.118, 0.067]	
Year 2017 (=1)	0.281**	0.314***
	(0.075)	(0.061)
	[0.100, 0.451]	[0.187, 0.445]
HH grows maize X Year 2017	0.055	
	(0.060)	
	[-0.070, 0.178]	
HH grows banana (=1)		-0.111*
		(0.042)
		[-0.199, -0.027]
HH grows banana X Year 2017		0.000
		(0.053)
		[-0.112, 0.110]
Baseline (2015) covariates:		
Male-headed HH (=1)	-0.054	-0.044
	(0.035)	(0.032)
	[-0.128, 0.026]	[-0.116, 0.028]
Age of the HH head (years)	-0.002	-0.002*
	(0.001)	(0.001)
	[-0.004, 0.000]	[-0.004, -0.000]
HH head can read and write (=1)	0.023	0.028
	(0.038)	(0.036)
	[-0.058, 0.111]	[-0.050, 0.111]
HH size (number of members)	0.014	0.014
	(0.007)	(0.007)
	[-0.000, 0.030]	[-0.001, 0.030]
Average elevation (m)	0.000	0.000
	(0.000)	(0.000)
	[-0.000, 0.000]	[-0.000, 0.000]
HH is member of a coffee cooperative (=1)	0.209***	0.213***
	(0.035)	(0.036)
	[0.119, 0.286]	[0.123, 0.290]
Number of coffee trees	0.000	0.000*
	(0.000)	(0.000)

Table 7 (cont'd)

	[-0.000, 0.000]	[-0.000, 0.000]
Kirehe district (=1)	-0.193*	-0.190*
	(0.075)	(0.065)
	[-0.402, -0.022]	[-0.375, -0.043]
Gakenke district (=1)	-0.006	-0.011
	(0.044)	(0.043)
	[-0.111, 0.106]	[-0.119, 0.095]
Rutsiro district (=1)	0.015	0.024
	(0.068)	(0.064)
	[-0.192, 0.193]	[-0.149, 0.172]
Constant	0.081	0.149
	(0.223)	(0.221)
Observations	1,024	1,024
R-squared	0.208	0.219

Notes: OLS regression. Standard errors clustered at the CWS level are in parentheses below coefficients. 95% confidence intervals from wild cluster bootstrap are in brackets. Huye is the omitted district.
* Significance at the 5% level
** Significance at the 1% level
*** Significance at the 0.5% level

We also tested two placebo outcome variables in DD regressions similar to equation 2: whether the farmer purchased mulch, and whether they used pesticide (either delivered by government or purchased). These regressions test whether awareness of zoning predicts purchasing mulch or using pesticide in 2017. In 2017, 66.5 percent of sampled farmers purchased mulch and 75.6 percent used pesticide. There is a 0.13 correlation between using pesticide and purchasing mulch. Table 8 presents the results of these regressions. Model 1 uses the outcome variable of purchasing mulch and Model 2 uses the outcome variable of using pesticide. The interaction of the household head being aware of zoning and the 2017 year dummy does not statistically significantly predict purchasing mulch or using pesticide.

Table 8: Placebo outcome variables - difference in differences results (dependent variable =1 if 2nd payment promised or received, =0 otherwise)

Placebo test: outcome variables	Model 1: Purchased mulch =1, =0 otherwise	Model 2: Used pesticide =1, =0 otherwise
HH head has heard of zoning (=1)	0.041	0.064
	(0.053)	(0.073)
	[-0.072, 0.168]	[-0.099, 0.225]
Year 2017 (=1)	0.072	0.113**
	(0.038)	(0.038)
	[-0.027, 0.153]	[0.032, 0.208]
HH head has heard of zoning X Year 2017	0.063	-0.055
	(0.042)	(0.076)
	[-0.023, 0.153]	[-0.203, .109]
Baseline (2015) covariates:		
Male-headed HH (=1)	-0.026	0.081
	(0.061)	(0.041)
	[-0.154, 0.102]	[-0.004, 0.167]
Age of the HH head (years)	-0.007***	-0.002
	(0.001)	(0.001)
	[-0.010, -0.004]	[-0.004, 0.001]
HH head can read and write (=1)	0.016	-0.009
	(0.053)	(0.042)
	[-0.104, 0.139]	[-0.095, 0.081]
HH size (number of members)	0.016	-0.005
	(0.012)	(0.007)
	[-0.011, 0.043]	[-0.021, 0.012]
Average elevation (m)	0.000	0.000*
	(0.000)	(0.000)
	[-0.000, 0.001]	[0.000, 0.000]
HH is member of a coffee cooperative (=1)	-0.010	0.094*
	(0.041)	(0.035)
	[-0.107, 0.085]	[0.010, 0.173]
Number of coffee trees	0.000	0.000
	(0.000)	(0.000)
	[-0.000, 0.000]	[-0.000, 0.000]
Kirehe district (=1)	0.050	-0.034
	(0.071)	(0.079)
	[-0.141, 0.199]	[-0.258, 0.152]
Gakenke district (=1)	-0.078	0.013
	(0.056)	(0.074)
	[-0.227, 0.057]	[-0.194, 0.181]
Rutsiro district (=1)	-0.017	-0.167*
	(0.066)	(0.077)

Table 8 (cont'd)

	[-0.204, 0.121]	[-0.402, -0.011]
Constant	0.250	0.256*
	(0.338)	(0.173)
Observations	1,010	1,024
R-squared	0.089	0.058

Notes: OLS regression. Standard errors clustered at the CWS level are in parentheses below coefficients. 95% confidence intervals from wild cluster bootstrap are in brackets. Huye is the omitted district.
* Significance at the 5% level
** Significance at the 1% level
*** Significance at the 0.5% level

3.5.4 Inference from qualitative data on zoning, second payments, and service provision

CWS manager interviews provide helpful information on the dynamics of zoning and second payments. According to interviewees and previous studies, when first implemented zoning was not uniformly implemented across Rwanda (Gerard et al., 2017). As previously mentioned, CWS managers in Huye specifically said that zoning was not implemented initially. There were different perspectives on how the policy was implemented, with all CWS managers saying that CWSs and traders could be punished if caught traveling into or across other zones to purchase cherry. CWS managers credited government restrictions on local trader activity with reducing farmer side selling.

Effects of zoning on second payments

A few CWS managers suggested that they specifically provided second payments because of zoning, but most managers suggested other influences on provision of second payments. Of the 16 CWS managers interviewed in 2019, 12 planned to provide second payments that season, two were unsure if they would provide second payments because of uncertainty about finances, and two were not going to provide second payments. Of the 12 planning to provide second payments, three said that the government influenced their decision, either through the zoning policy or a

broad request that CWSs provide second payments. One manager said, “We are providing the second payment every year especially after the zoning policy. Before the zoning policy, provision of the second payment depended on how the CWSs worked but after the zoning policy, [we must] provide them.”

For CWSs that did not credit zoning or requests from government for their decisions to provide second payments, the primary reason for providing them was wanting to motivate farmers to invest in their coffee. Additional farmer investment would allow for greater productivity and more coffee for CWSs, which is helpful because they cannot purchase coffee from outside of their zones. Other reasons for providing second payments included profit sharing being an obligation of cooperatives and provision of second payments being expected in their region.

There are countervailing issues that may limit the ability of some CWSs to provide second payments. Eleven of 16 CWSs did not provide second payments in 2018 because of a lack of profits. However, many of these CWSs were optimistic about their 2019 sales and planned to provide second payments. All cooperative-owned CWSs in the sample planned to provide second payments in 2019, likely because they are required to provide second payments by their by-laws. This is consistent with other findings from Rwanda, which suggest that cooperative-owned CWSs were generally more likely to provide second payments than private CWSs (Ortega et al., 2019).

Effects of zoning on relationships between CWSs and farmers

While second payments are a helpful proxy for relationships between CWSs and farmers, zoning may affect relationships between farmers and CWSs in other, related ways. For example, of the 16 CWS managers interviewed, nine said that they increased service provision because of

zoning. Services provided included training on good agricultural practices, credit, transportation to pick up or deliver government-provided inputs, and provision of domestic animals (e.g., pigs, chickens, etc.). Three CWS managers said that zoning hurt service provision (two of these were from cooperative-owned CWSs). Another cooperative-owned CWS representative said that while zoning improved services within the zone, it hurt farmers outside of the zone who had previously sold to them. The remaining two CWS managers said that services did not change because of zoning.

There were similar dynamics with CWS managers' views about how zoning had affected their relationships with farmers. Most said it improved relationships, though some cooperative-owned CWS managers said that it hurt relationships with members by removing the members from their zones. One private CWS manager said, "Before zoning, there was no relationship between the CWSs and the farmers. The CWSs were purchasing cherries during the season and after the season they immediately go away and the farmers didn't have a relationship with CWSs. But after zoning, the farmers are like the kids, the wife and the family member of the CWSs."

In addition to impacts on service provision and relationships, four cooperative CWS managers said that they had lost a substantial number of farmers through development of zones. This reduced coffee production and hurt the cooperatives.

3.6 Discussion

Quantitative findings suggest that coffee farmer awareness of zoning is positively associated with being promised or receiving second payments in 2017. In addition, being in Huye—where zoning was considerably less implemented than other districts—is negatively associated with being promised or receiving second payments in 2017. This is consistent with previous studies

that suggest that rather than holding up suppliers, under monopsony systems buyers may encourage farmers to produce greater volumes by providing high prices and helpful services (Key & Runsten, 1999; Maertens et al., 2011; Minten et al., 2009).

If zoning influenced CWSs to provide second payments, it is likely to have been for one or more of the following reasons: (1) a desire for farmers to produce more coffee coupled with confidence that coffee would be purchased by the CWS rather than competitors; (2) higher profits due to reduced farmer side selling, which they passed on to farmers; and/or (3) government encouragement to provide second payments as part of zoning. Qualitative data provides additional information on CWS motivations for providing second payments. A few CWS managers said that zoning or the government was directly responsible for them providing second payments. Others, however, suggested that motivating farmers to invest in their coffee was a primary reason for providing second payments. It is unclear whether this was a motivation for providing second payments prior to zoning. Since zoning restricted the number of coffee farmers CWSs could purchase from, motivating farmer investment may be more important under zoning.

Interviews suggest that zoning's success may be due to a reduction in traders moving across zones and bans on direct competition between CWSs. This supports the idea that, prior to zoning, CWS-driven competition was one of the problems creating a barrier for positive relationships between farmers and CWSs (Macchiavello & Morjaria, 2019). In interviews, CWS managers—particularly those for private CWSs—were positive about the ability to build longer-term relationships with farmers without the threat of high levels of side-selling. Cooperative-owned CWSs, however, suffered due to a loss of farmers. Cooperative-owned CWS managers also

believed that cooperative members who were no longer able to supply them coffee suffered because they no longer received cooperative services or (in some cases) bonuses for certification. The perceived success of zoning by some CWS managers is interesting because individual farmers are rarely, if ever, penalized for side-selling. Relatively low farmer awareness of zoning and lack of punishments for farmer side-selling reduce the stringency of the policy. While limited farmer awareness of the policy can create confusion and may enable local traders to exploit farmers when purchasing their coffee, a lack of punishments for individual farmers may hold benefits. Allowing (or ignoring) small-scale side-selling may prevent wholesale exploitation of farmers by CWSs.

3.7 Conclusions and implications

This paper contributes to the literature on contract farming and specifically monopsony buying systems as an approach to overcoming contract enforcement problems. It does so by providing a unique example of a regional, government-implemented zoning system. Quantitative and qualitative evidence suggests that Rwanda's zoning policy, where effectively implemented, has been associated with increasing coffee farmers' odds of being promised or receiving second payments and with provision of better services to farmers by coffee washing stations. All else equal, being aware of zoning in 2017 is associated with a 36.5 percent increase in the odds of being promised or receiving a second payment compared to the baseline (2015) value.

A primary implication of these findings for Rwanda's implementation of zoning is that improved outreach may be necessary to share information and receive feedback from farmers and cooperatives. While farmer awareness of zoning may have improved since then, as of 2017 a surprising percentage of farmers had never heard of zoning. Outreach to farmers is critical when

rolling out policies that directly affect farmer livelihoods and that are designed to constrain their behavior. Given the correlations between awareness of zoning and other characteristics such as literacy, household head gender, and cooperative membership, the government should develop strategies to reach disconnected farmers with important information.

In addition to communicating with disconnected farmers, collaboration with farmer cooperatives in designing zones may reduce the harm caused by splitting off their members. It may be possible to re-draw zones such that cooperative members are able to sell to their cooperatives via collection centers even if they are physically distant from the cooperative-owned CWS.

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CHAPTER 4: PERSPECTIVES OF FEMALE COFFEE FARMERS IN RWANDA: IDENTIFYING PROBLEMS AND DEVELOPING SOLUTIONS FOR COFFEE PRODUCTION

4.1 Introduction

In developing countries, female headed households face challenges in profiting from agricultural production compared to male headed households. In Sub-Saharan Africa, female household heads (HHHs) face challenges such as limited income, scant household labor, lack of access to credit, and limited access to agricultural inputs and technology (Ansoms & Mckay, 2010; Croppenstedt, Goldstein, & Rosas, 2013; Doss, 2001; Doss & Morris, 2001). Widows in post-conflict countries such as Rwanda may face additional problems, such as physical injuries, psychological trauma, and a loss of assets (Bozzoli & Bruck, 2009; Brück & Schindler, 2009). In Rwanda, where female HHHs made up 35 percent of the population as of 2010, many farmers of key exports such as coffee and tea are female HHHs (Daley, Dore-Weeks, & Umuhozac, 2010). While basic information about challenges facing female HHHs in agricultural production in post-conflict countries is available (Croppenstedt et al., 2013), it is important to understand the perspectives of female HHHs: how they view their problems and what they believe can help solve their problems. This study addresses these issues using the experience of female HHHs in Rwanda's coffee sector.

In Rwanda, coffee is a critical export providing income to more than 350,000 farming families (Clay, Bro, Church, Ortega, & Bizoza, 2018). These families include thousands of female-headed households, in which a woman—often a widow of the 1994 genocide—manages the farm[7]. Rwandan female HHHs face challenges in profiting from their agricultural production due,

7 While we do not have national-level data available, survey data from 1,024 farmers in four provinces suggests that around 18 percent of coffee farming households are female-headed.

among other things, to poverty, limited household labor, and weak land tenure (Ansoms & Mckay, 2010; Bidogeza, Berentsen, Graaff, & Oude Lansink, 2009; Bozzoli & Bruck, 2009; Jones-Casey, Dick, & Bizoza, 2014).

In this paper we first broadly consider the problems faced by female HHHs in profiting from coffee production in Rwanda. We then present (1) problems identified as most important to a sample of female HHHs, (2) mental model diagrams of relationships between problems and possible causes of these problems, and (3) interventions female HHHs believe could help solve these problems. In addition to the problems identified by them, we also focus on weak input access and use, a problem for Rwandan female HHHs growing coffee that has been previously identified (Gerard, Clay, Lopez, Bowman, & Rukazambuga, 2018).

This paper uses quantitative data from across Rwanda and qualitative data from Southern Province, a prominent coffee-growing area. Data was collected iteratively and in stages between 2015 and 2019, which allowed for learning on the part of the investigators and for investigators to use that knowledge to inform study design. This is portrayed using survey data on issues facing female HHHs, followed by data from interactive workshops conducted to explore problems and potential solutions.

This paper contributes to our understanding of challenges faced by developing country female HHHs in agriculture (Ansoms & Mckay, 2010; Croppenstedt et al., 2013; Doss & Morris, 2001; Peterman, Behrman, & Quisumbing, 2014), but also builds on previous studies to describe how input distribution policies can impact sub-populations such as female HHHs in unique ways (Jayne, Mason, Burke, & Ariga, 2018; Kilic, Whitney, & Winters, 2015). In addition, this study provides helpful data about dynamics of female HHH pesticide use and investment in hired

labor, two specific areas where little evidence has been published (Peterman et al., 2014). Methodologically, this paper uses a unique combination of data collection (survey, problem tree, and focus group) and analytic (descriptive statistics, qualitative coding, and mental model diagrams) approaches that help delve not only into problems, but more importantly into solutions.

Research questions

The following questions guide this study:

(1) What barriers do female household heads face in profiting from coffee production? In particular, what barriers do female household heads face in accessing and using inputs?

(2) What solutions might female household heads identify to address these challenges?

4.2 Background on Rwanda's coffee sector

In Rwanda, farmers grow coffee on small plantations and deliver fresh coffee cherry for sale to coffee washing stations (CWSs) (Clay et al., 2018). CWSs are mills that purchase cherry from farmers, and then process it, producing "parchment" that is sold to exporters (Daviron & Ponte, 2005). Two types of CWSs exist in Rwanda: private and cooperative-owned. Fourteen percent of Rwandan coffee farmers are members of a farmer cooperative and many cooperative members sell their coffee to a cooperative-owned CWS (Ortega et al., 2019). Cooperatives provide services such as training and "second payments" (dividends from profits) and have been shown to improve income for coffee farmers (Ortega et al., 2019).

Rwanda's coffee sector is partially liberalized, with several important policies that influence farmers (Boudreaux, 2011). These include a government-set farmgate price for coffee cherry, government purchase of pesticide and fertilizer and distribution by the Coffee Exporters and

Processors Association of Rwanda (CEPAR), and a monopsony zoning policy that requires CWSs to solely purchase coffee from farmers within a geographic zone (Clay et al., 2018; Gerard, Clay, & Lopez, 2017; Gerard et al., 2018).

Rwandan coffee farmers have low productivity compared to farmers in neighboring countries, in part because of insufficient farmer investment (Clay et al., 2018). Previous research suggests that low coffee prices have contributed to low farmer investment (Clay et al., 2018). As a result, Rwandan farmers make less money per kilo of fresh coffee "cherry" than farmers in neighboring countries (Clay et al., 2018).

Rwanda's input distribution system is organized such that CEPAR distributes pesticide and fertilizer to all farmers based on the number of trees that they have on their plantations—according to a 2015 coffee census—and farmers or cooperatives retrieve those inputs from local government (Gerard et al., 2018). This system is structured similarly to some input subsidy programs in Southern Africa in that inputs are purchased in bulk by the government and then distributed to farmers based on certain characteristics, in this case number of trees (Jayne et al., 2018). In theory all farmers growing coffee should receive distributed inputs, however previous research suggests that female HHHs are less likely to use distributed inputs, which suggests that there may be a gap in input access or barriers to use (Gerard et al., 2018). One difference between Rwanda's coffee input distribution system and some other countries' systems is that rather than providing vouchers that farmers can bring to an agro-dealer, CEPAR distributes bulk fertilizer and pesticide using lists with farmer names and volumes they are supposed to receive (Liverpool-Tasie, 2014b; Pan & Christiaensen, 2012).

4.3 Literature review

4.3.1 Gender and agriculture in Rwanda

While there is a diversity of gender roles in African agricultural production, in many cases men cultivate cash crops or reap the financial benefits of cash crop production (Doss, 2001). In Rwanda, women historically did not cultivate and market coffee (Randolph & Sanders, 1988). However, in the years since the 1994 genocide many women cultivate coffee, either as a head of household who owns a plantation or as part of a couple. Despite the expansion of women farming coffee, there are additional barriers to marketing cash crops, such as discrimination or harassment by buyers (Vargas Hill & Vigneri, 2014).

In Rwanda, several studies have focused on gender and agriculture generally, but few consider female-headed households in agricultural production (Abbott, Mugisha, & Sapsford, 2018; Elder, Zerriffi, & Billon, 2012). Those that do suggest that Rwandan female HHHs face challenges similar to those identified in other developing countries. Bidogeza et al. (2009) studied determinants of agricultural technology adoption, finding that female headed households were less likely to adopt highly technical inputs, perhaps because of a lack of income or technical knowledge. A similar study by Ansoms and McKay (2010) analyzed livelihoods in rural Rwanda, finding that female-headed households were the poorest types of households, with fewer crops grown and less agricultural trade than other types of households, and less access to household labor.

As of 2010, approximately 35 percent of Rwanda's households were female-headed (Daley et al., 2010). In the 1994 genocide, approximately 1 million people were killed, the majority of them men (Debusscher & Ansoms, 2013; Rieder & Elbert, 2013). This, and the exile and arrests of

suspected genocide perpetrators, led to a shortage of men, a dynamic that facilitated the development of gender equality policies (Debusscher & Ansoms, 2013; Warner, 2016). Historically, men had the right to own land in Rwanda while women did not, and land was transferred from father to son (Isaksson, 2015; Jones-Casey et al., 2014). Widows were often sent home to their family, with their deceased husband's land going back to his family (Lankhorst, 2012). Following the genocide, Rwanda's government enacted laws to improve land regulation and land tenure for women (Daley et al., 2010; Jones-Casey et al., 2014). However, there is evidence that despite *de jure* reforms, the *de facto* situation involves weak land tenure for many women. For example there is evidence that in-laws still try to grab land from widows and that local leaders often adjudicate land against women (Daley et al., 2010; Lankhorst, 2012). The local implementation of reforms is important because secure land tenure promotes long term investment (Ali, Deininger, & Goldstein, 2014; Deininger & Feder, 2009), because a feeling of security and self-esteem allows women to more effectively farm and care for their families (Kumar & Quisumbing, 2015), and more generally because the guarantee of access to land is associated with women having more power over that land (Agrawal, 1994).

4.3.2 Gender and agricultural input access and use

Inorganic fertilizer and pesticides have been important in improving agricultural productivity in developing countries. However, there have been differences in female and male farmers' access to and adoption of these technologies (Peterman et al., 2014). Studies suggest that given equal access to fertilizer and complimentary inputs, female farmers use it at the same rate as male farmers (Doss & Morris, 2001; Peterman et al., 2014). However, female farmers may not have access to fertilizer or complementary inputs such as labor and land (Doss & Morris, 2001).

In reviewing research on inputs, labor, and technology availability, Peterman, Behrman and Quisumbing note that while many papers have focused on women's use of fertilizer, little has been written on women's pesticide use (2014). However, existing studies suggest that in some contexts female farmers may be at risk of health problems due to a lack of knowledge about safe pesticide usage (Atreya, 2007) and that gender discrimination may reduce pesticide access (Kinkingninhoun-Mêdagbé, Diagne, Simtowe, Agboh-Noameshie, & Adégbola, 2010).

In addition, while some studies suggest that female farmers are more likely to use hired labor than men, little is known about *why* they might use hired labor (Peterman et al., 2014). One potential reason that female HHHs in particular may hire labor is that some agricultural tasks are gendered, in part because they may be more physically difficult for women (Peterman et al., 2014). It is also possible that women have responsibilities within the household like cooking or taking care of children, and so they may choose not to perform some tasks themselves that may endanger others.

In the case of Rwandan coffee, we can differentiate access to pesticide and fertilizer and their use. Because CEPAR distributes coffee pesticide and fertilizer and few farmers purchase it, use is predicated on receiving distributed inputs. In its coffee pesticide and fertilizer distribution system, Rwanda is similar to other African countries that subsidize and distribute inputs. In "smart subsidy" programs, inputs should be accurately distributed to those who have been targeted (Jayne et al., 2018). However, evidence suggests that in many programs there is weak targeting for poverty, gender, and farm size and inputs do not reach their intended recipients (Jayne et al., 2018; Kilic et al., 2015). In Malawi, Nigeria, and Tanzania fertilizer aimed at female HHHs was equally likely to go to men, and in some cases female HHHs were less likely

to receive fertilizer (Jayne et al., 2018). While weak targeting is a potential problem, so is diversion of vouchers by local elites (Liverpool-Tasie, 2014a; Mason & Smale, 2013; Pan & Christiaensen, 2012). The combination of weak targeting, local diversion, and physical capability differences between male and female farmers suggests that input distribution programs such as Rwanda's may face problems in benefiting vulnerable farmers. These farmers may not be able to access the inputs if those inputs do not reach them, and they may not use the inputs if the farmers do not have the capabilities to do so or choose not to use them.

4.4 Methods

This paper used a mixed methods approach to data collection and analysis. The data used in this paper was collected over four years. It started with exploratory questions around the limitations female HHHs have in producing coffee. Initial questions were addressed through a farmer survey. Based on findings from that survey and subsequent engagement with coffee sector stakeholders, we decided to conduct workshops with women to inquire about their problems growing coffee and potential solutions.

4.4.1 Survey data collection and analysis

Quantitative data used in this study comes from a survey of 1,024 farmers conducted in 2015 and a follow-on survey with half of this sample (512 farmers) in 2017. Data was collected in Northern, Southern, Eastern, and Western provinces, in coffee-producing areas. Four CWSs were identified in each province—two cooperative-owned and two privately owned, and 64 farmers were randomly sampled from each CWS's farmer list (16 CWSs total X 64 farmers = 1,024). A random sample of 512 of these farmers was taken in 2017. The survey included questions on agricultural investment, productivity, and demographic information, among other types of

information. We use this survey to provide descriptive data on differences between female and male HHHs and between female HHHs who are and are not members of cooperatives.

Initial analysis of survey data suggested that female HHHs faced challenges related to input use. We do not have survey data on pesticide and fertilizer access. However, because CEPAR distributes nearly all pesticide and fertilizer to Rwandan coffee farmers, a lack of pesticide and fertilizer use suggests either a lack of access or the inability to use or decision not to use available inputs.

We found that there was a gap between male and female HHHs in use of pesticide distributed by CEPAR. This gap remained even as input distribution generally improved between 2015 and 2017 and the gender gap in fertilizer use disappeared. Because each farmer should receive pesticide, we wanted to understand what might keep women from accessing or using it. Was it discrimination because of their gender, limited coffee production, or poverty? Was the pesticide available, but the women did not have the means of using it? Or perhaps, as some stakeholders suggested, it was women's concern about pesticide residue contaminating food that they cooked for their families. Our goal in conducting this research was to go beyond the question of what might be causing difference in pesticide use to understand female HHHs' perspectives about the problems they faced and what solutions might address these problems.

4.4.2 Qualitative data collection and analysis

Workshops

We held six workshops in Southern Province in 2019: three with cooperative members and three with non-members. We conducted research in Southern Province because it is an important coffee growing area with well-established cooperatives. During the workshops, we started by

discussing the biggest problems facing female HHHs broadly and then focused on input-related challenges. This approach had two benefits. First, if lack of inputs was an urgent problem for farmers as it was reported in the literature, it likely would come up when discussing problems more broadly. Second, this approach allowed us to understand the connections between problems facing female HHHs, such as between input availability, labor costs, and coffee prices.

We worked with two CWSs that were used to sample farmers for the 2015 survey[8]. One CWS was owned by a cooperative and the other was privately owned. We held workshops with cooperative members and with non-members because we wanted to understand how cooperative membership might influence female HHHs' coffee production. Both CWSs provided access to lists of female HHHs who supply them. We used a random number generator to sample 30 female HHHs from each CWS.

We reached women either by phone or through CWS staff to invite them to the workshops. When inviting them to workshops, we explained that we wanted to ask questions about their coffee production. We informed them that we would provide a stipend to cover their costs of missing work and transportation, as well as lunch. We told them that all individual information would be confidential, and that we were independent from their CWS.

Each workshop included between 8-10 participants, for a total of 57 women. Workshops were held in meeting rooms at CWSs. CWS staff were not allowed to be present during discussions to allow participants to speak freely. All discussions were conducted in Kinyarwanda and simultaneously translated into English by facilitators. We took notes and recorded conversations with consent from the participants.

8 In addition to data collection with these two CWSs, we piloted the workshop approach with farmers at another private CWS in Southern Province.

At the beginning of each workshop, we used an intake form to collect demographic information on participants. This provides information on the sample of women who attended workshops, which can be compared with the demographics of women included in the 2015 farmer survey. See table 9 for this information.

Table 9: Demographic information on female HHHs in the two samples

	Total # in sample	**% in cooperative**	**Avg. age**	**Avg. household size**	**% able to read**	**% widow**	**Avg. trees in plantations**
2015 survey	189	62.4%	58	4.2	49.2%	77.8%	596.2
2019 workshops	57	49.1%	59	4.0	49.0%	73.7%	423.4

Because of how we organized sampling, around half of female HHHs in workshops were cooperative members. Female household heads attending workshops ranged in age from 34 to 81, with an average age of 59. Household sizes ranged from 1 to 8, with an average size of 4 people. 49 percent of participants were able to read. 73.7 percent of participants were widows. Female HHHs who were not widows were a mix of women whose husbands were in prison, who had never been married, and who were separated. There was substantial variation in farm sizes, with the number of trees in plantations ranging from 62 to 2,000, with an average of 423.4 trees. Demographics between female HHHs in the farmer survey sample and women attending workshops were similar, with the primary difference being that in the survey a greater proportion of female HHHs were cooperative members. In workshops, we intentionally sampled around half of women from cooperatives whereas in the survey we aimed for half of *all* farmers (regardless of gender) to be cooperative members.

We asked participants to brainstorm problems for women in making money from coffee. After they had identified major problems (groups identified between 10-19 problems), they came to

consensus on a focal problem through discussion. They were asked to choose one problem that was important, but also a problem on which progress might be made in the next few years so that there was a reasonable potential for action when developing solutions.

After the group identified their focal problem, we used a problem tree approach to explore causes and consequences of it (D'Haese, van Rooyen, van Huylenbroeck, & D'Haese, 1998; Thiam, Muchapondwa, Kirsten, & Bourblanc, 2015). We drew a problem tree on a flip chart to identify the causes of the problem (the roots of the tree) and the effects of the problem (the branches). Participants then voted on the most important causes. Through voting women identified the top three causes, which would be the focus for discussions about potential solutions. In two cases, participants wanted to choose "Low farmgate price" as the top problem, however we suggested that this would be a difficult cause to develop solutions for because it is solely controlled by the government. In these cases, groups agreed to focus on another high-priority cause. See Appendix I for a photo of a problem tree.

Focus group discussion followed the problem tree exercise and focused on the top three identified causes of the focal problem. We first asked clarifying questions, and then asked about potential solutions using a semi-structured focus group protocol. After reaching consensus on the dynamics of causes and potential solutions, we asked questions about pesticide and fertilizer access and use.

Workshops data analysis

Upon collecting data, we translated transcripts of discussions from Kinyarwanda into English for analysis. These transcripts were analyzed alongside field notes taken during the workshops.

Based on the information collected through the workshops, we created mental model diagrams for workshop sub-samples. Mental models are a conceptualization of the schemas people use to make sense of their lives (Wood, Bostrom, Bridges, & Linkov, 2012). Mental models are specifically helpful when relationships are non-linear or there are feedback loops between variables. Following Rivers, et al, we developed visualizations of mental models for the cooperative sub-sample and the non-cooperative sub-sample based on their problem trees and insights gathered from workshops (2018).

Both to build mental model diagrams and describe potential solutions, we coded focus group discussions in NVivo using a codebook developed from theory related to gender and agricultural investment and emergent topics from the discussions. To move from problem tree outputs and focus group transcripts to mental model diagrams, we identified relationships between variables and the direction of these relationships.

Nodes in mental model diagrams largely come directly from problem trees; they are causes or problems from problem trees, or necessary steps between these causes or problems. Connections between nodes were identified using the "effects" (branches) from the problem tree and focus group discussions. In general, connections came from areas of consensus between participants rather than isolated statements. As an example, in the cooperative member mental model (Figure 4) there is a positive connection between the node Loan Repayment Period and the node Sufficient Loans, implying that an increase in the loan repayment period would cause loans to be more sufficient. Sufficient loans in turn positively influence having cash that can be used for investment in coffee. This was a relationship derived from the problem tree, but also was supported by statements in the focus group. Example statements include:

a. “It is good to have a bigger loan we can pay within three years”

b. “If I get long loans, I can renew the house as it is too old because it was built in 1969 and I can therefore buy the iron sheets to replace the tiles. And I can invest the remainder in coffee.”

c. “If you ask [for] a long-term loan, then the activities are expanded.”

We created mental model diagrams using Kumu.

4.5 Results

We first present survey data on differences between (1) male and female HHHs and (2) female HHHs who are and are not cooperative members. We then present findings from workshops.

4.5.1 Quantitative results

Differences between male and female HHHs

Table 10: Descriptive statistics between male/female HHHs from 2015 survey data

	National sample		Southern Province sub-sample	
Variables	Female HHHs	Male HHHs	Female HHHs	Male HHHs
Number of farmers	189	835	58	198
Percent of sample	18.5%	81.5%	22.7%	77.3%
Age	58.1***	49.5	57.6***	49.5
% widowed	77.8%***	2.0%	75.9%***	2.0%
Household size	4.2***	5.6	4.1***	5.6
Household income (Rwanda francs)	362,639.5*	614,516.3	319,625.9	428,242.6
# productive coffee trees	596.2	767.7	598.8	614.9
Total land owned (M^2)	10,243.9*	12,380.4	8,271.2	9,257.6
% use pesticide	61.4%*	70.5%	62.1%***	82.3%
% use fertilizer	65.6%	72.2%	63.8%	76.3%
% uses manure	51.9%*	61.1%	43.1%	53.0%

Notes: Means or percentages, as appropriate, are included in columns. * indicates level of significance in difference in statistical tests between male and female HHHs. * = significance at the 5% level; ** = significance at the 1% level; *** = significance at the 0.5% level. T tests are used in comparing continuous variables with categorical gender variables and Chi^2 tests are used for comparing gender variables with other categorical variables.

In table 10, find a comparison of female and male-headed households from the 2015 national farmer survey and in the Southern Province specifically.

There are important demographic differences between female and male HHHs in the national sample. Female HHHs were statistically significantly older, were more likely to be widows, and had fewer people in their households than men. Demographic dynamics were similar between the national sample and the Southern Province sub-sample with statistically significant differences between male and female HHHs in Southern Province on age, percent widowed, and household size.

In the national sample, female HHHs had a statistically significantly lower annual income than male HHHs, which is unsurprising given their age, small household sizes, and small land holdings. In terms of productive assets, the mean number of productive coffee trees for male and female HHHs is not significantly different in the national sample, however men owned significantly more land than female HHHs. None of these differences (income, number of trees, and land owned) were statistically significant in the Southern Province sub-sample.

In the national sample, there was not a statistically significant difference between rates of fertilizer use by female and male HHHs, however female HHHs were significantly less likely than male HHHs to use pesticide. In Southern Province, this gap was larger, with male-headed households substantially more likely to use pesticide than female-headed households. In Southern Province there was not a statistically significant difference in fertilizer usage between male and female headed households.

Female HHHs were significantly less likely to use manure than male HHHs in the full sample. CEPAR does not distribute manure, so using manure requires purchasing manure or owning domestic animals. In the Southern Province sub-sample, differences in manure use were not significant.

Differences between female HHHs who are and are not cooperative members

Table 11: Comparison between female HHHs who are cooperative members vs. non-members. National sample. Averages or percentages in group, as appropriate.

Variables (2015)	Cooperative members	Non-members
Number of farmers	118	71
Percent of sample	62.4%	37.6%
Age	57.5	59.3
% who are widowed	78.0%	77.5%
Household size	4.5*	3.8
Household income (Rwanda francs)	451,758.3**	214,526.5
# productive coffee trees	793.6***	268.1
Total land owned (M^2)	11,941.7**	7,422.1
% who use pesticide	71.2%***	45.1%
% who use fertilizer	71.2%*	56.3%
% who use manure	56.8%	43.7%

Means or percentages, as appropriate, are included in columns. * indicates level of significance in difference in statistical tests between female HHHs who are and are not cooperative members. * = significance at the 5% level; ** = significance at the 1% level; *** = significance at the 0.5% level. T tests are used in comparing continuous variables with categorical cooperative membership variables and Chi^2 tests are used for comparing cooperative membership variables with other categorical variables.

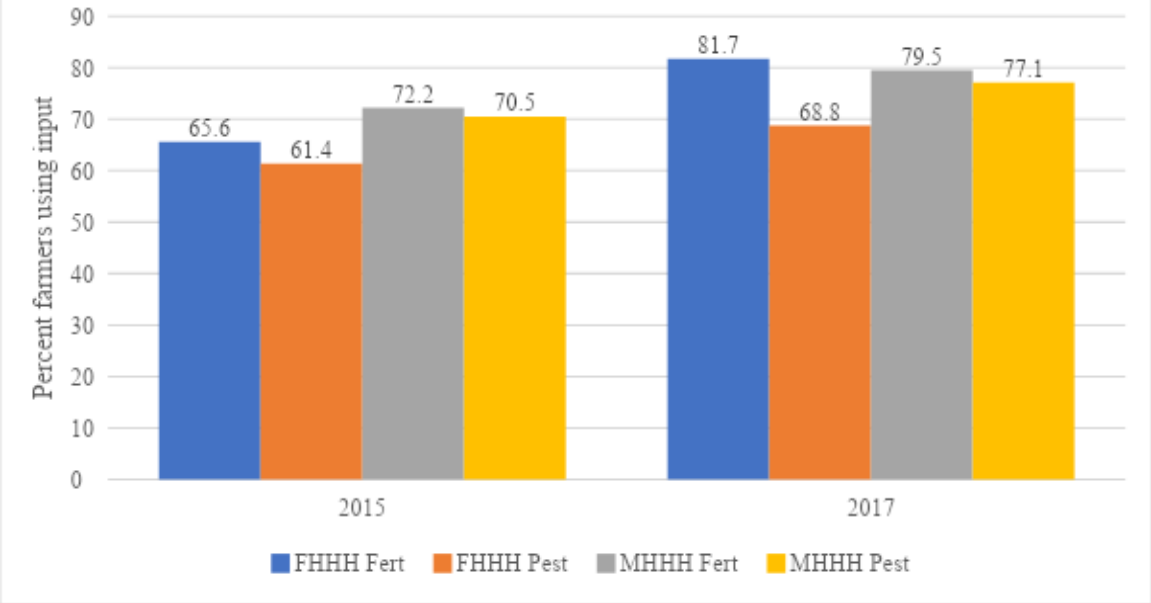
In the national survey, there were substantial differences between female HHHs who are and are not cooperative members. Cooperative members were in a more advantageous position than non-members, with large, statistically significant differences on several variables. Cooperative members had slightly larger household sizes, which may imply more family labor availability. They had over double the annual income of non-members, nearly three times as many productive coffee trees, and substantially more land. Cooperative members were more likely to use pesticide

and fertilizer distributed by CEPAR than non-members. The difference in pesticide use was large, which may be because some cooperatives provide pesticide spraying services.

Changes in pesticide and fertilizer use

Between 2015—when the baseline survey was collected—and 2017, Rwanda's government expanded the reach of its input distribution system (Gerard et al., 2018). The overall percentage of farmers using pesticide increased from 68.9 percent in 2015 to 75.6 percent in 2017. The percentage of farmers using fertilizer increased from 71.0 percent in 2015 to 79.9 percent in 2017. Although there was not a statistically significant difference between male and female HHHs in fertilizer use nationally in 2015, Figure 3 shows that the percent of female and male HHHs using fertilizer converged to being nearly equal by 2017. In pesticide, however, the gap in usage between male and female HHHs remained at around nine percentage points, though this difference was no longer significant at the 0.5 level (it was significant at the 1 percent level). A discussion of potential causes of this gap can be found in section 4.5.4.

Figure 3: Changes in pesticide and fertilizer use by HHH gender, 2015 and 2017



4.5.2 Qualitative results

In this section, we first describe focal problems and their causes identified through the problem tree activity. We then present mental model diagrams and findings on challenges to pesticide and fertilizer access and use. Finally, we describe solutions identified by workshop participants.

Problems and their causes

As noted, the problem tree activity provided groups an opportunity to identify the most important barrier to profiting from coffee. Once they had identified this focal problem, they brainstormed causes and effects of the problem. Finally, they voted on the most important causes, which they used in focus group discussions to design solutions. While focal problems and top causes are presented in Table 12, an analysis of all brainstormed problems can be found in Appendix II. Table 12 presents (1) the focal problems identified by a sub-sample (three groups) of cooperative members and a sub-sample (three groups) of non-members, (2) the main causes of those problems as voted on by group members, and (3) other causes of the focal problem the group discussed which received at least two votes. Results for groups of cooperative members are identified with a C and non-member groups are identified by NM. There is one focal problem for each group, and three top causes of each focal problem.

Table 12: Top Problem with top causes identified for each

Group	Focal problem	Cause 1	Cause 2	Cause 3	Other causes of focal problem (receiving 2+ votes)
C1	Insufficient labor	Lack of self-confidence keeps women from hiring laborers	Lack of cash	Low price for other crops	Living alone without help; discrimination by community; hail that destroys crops
C2	Lack of loans	Lack of skills to make project proposals	Repayment of loans in short time periods	Loans are too small	Delay in getting loans from cooperative
C3	Low return on investment (ROI) for coffee	Not enough equipment	High labor costs	Lack of manure; delays in getting inputs	*Low farmgate price; CWS shutting down while coffee still being harvested; high transport costs for mulch
NM1	Insufficient labor	Living alone in the household	Poverty	Lack of manure	Lack of cash to pay laborers; insufficient fertilizer; not living in peace with neighbors
NM2	Problems accessing inputs	Lack of domestic animals	Delays in fertilizer distribution	Delays in pesticide distribution	Insufficient pesticides; not having cash; low farmgate price
NM3	No help in coffee management activities	Poverty	Must hire labor because they are weak	Lack of financial management skills	Having to hire laborers to grow other crops

*Low farmgate price was a top voted cause, but facilitators advised group not to focus on this for discussion because farmgate prices are set by government and identifying solutions to such a problem would be difficult.

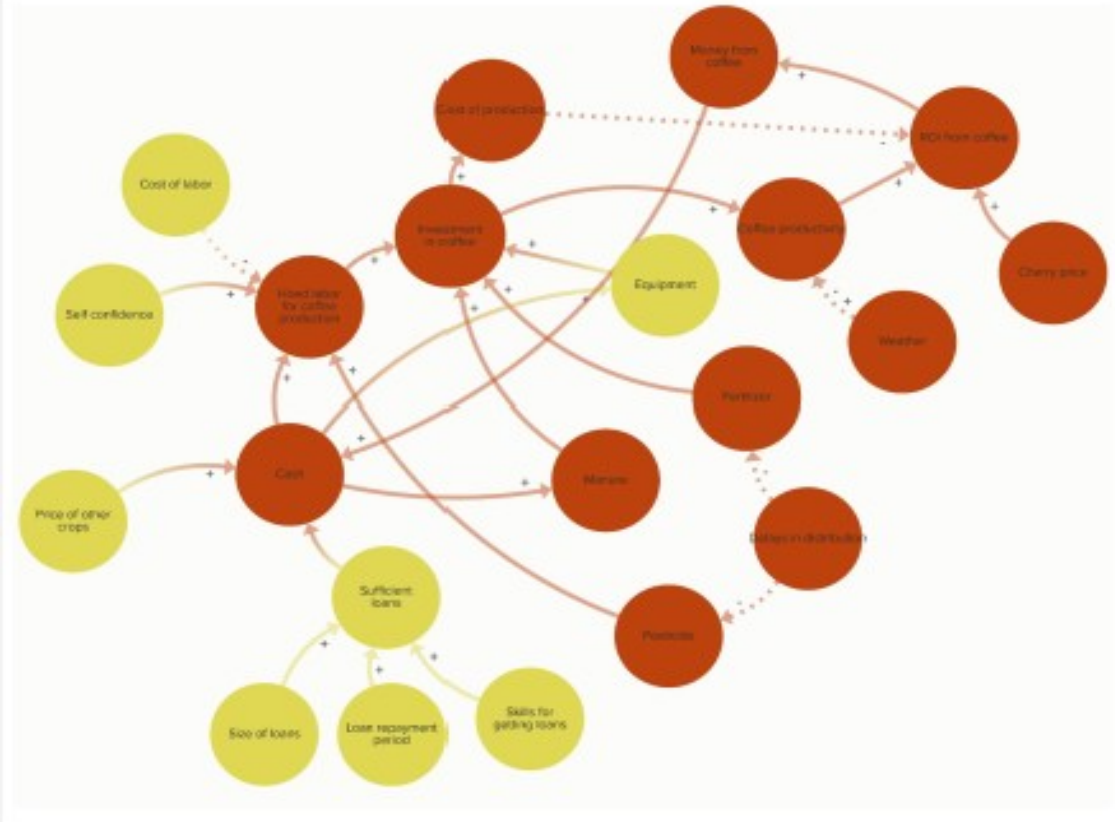
Mental model diagrams

Through analyzing problem tree outputs and focus group discussions, we created mental model diagrams for cooperative member and non-member sub-samples. In these diagrams, the outcome of interest is making money from coffee—the starting topic of discussion for problem trees—

which is a function of the return on investment in coffee. Return on investment in turn is a function of the cost of production, the volume of coffee production, and the cherry price. In this section, we use mental models to describe the relationships between focal problems and other variables.

Mental model: Cooperative member sub-sample

Figure 4: Cooperative sub-sample mental model diagram



In figure 4, the dark rings are those elements that apply to both cooperative member and non-member sub-samples. They apply to both because (1) they were identified by both sub-samples or (2) because they are necessary steps based on the structure of Rwanda's coffee sector (in which case they were inferred by the authors). The light rings are those that only cooperative member groups discussed. Solid arrows with plus signs are positive relationships, in which

increasing one node increases the other. Dotted arrows with minus signs are negative relationships, in which increasing one node decreases the other. We discuss the focal problems of labor, lack of financing, and low return on investment and how they relate to other variables in the mental model below.

Focal problem—Insufficient labor: There are different causes to the problem of a lack of labor; some are purely economic, but others are related to how the society treats widows.

As can be seen in figure 4, some cooperative members suggested that high costs of labor and low self-confidence reduce their ability to hire laborers. This in turn reduces investment in coffee, which reduces productivity and ultimately income. Having sufficient cash allows for both hiring laborers and investing more broadly. Women said that low prices for non-coffee crops and not having sufficient loans reduced access to cash. Low prices of other crops affect labor by reducing the amount of cash that comes into the household. Insufficient loans had a similar effect; it meant they did not have cash when they needed it and could not sufficiently invest.

Women in group C1 suggested that low self-confidence keeps them from hiring laborers. They had low self-confidence in large part because of how people in their communities treat them. For example, some male laborers will try to have sex with them if they hire them, as a woman explained:

> Some men come to the household headed by widows and propose them to become their husbands [or have sex with them] and these women refuse and the men go away spreading the news that they are bad people and mobilizing other men not to work for them; hence lack of workers even though they have the money to pay them.

In addition, cooperative members said that if they hire men who are married, those laborers' wives may become jealous. Participants said that they do not like to go to restaurants or bars alone to talk to potential laborers because they may get a bad reputation.

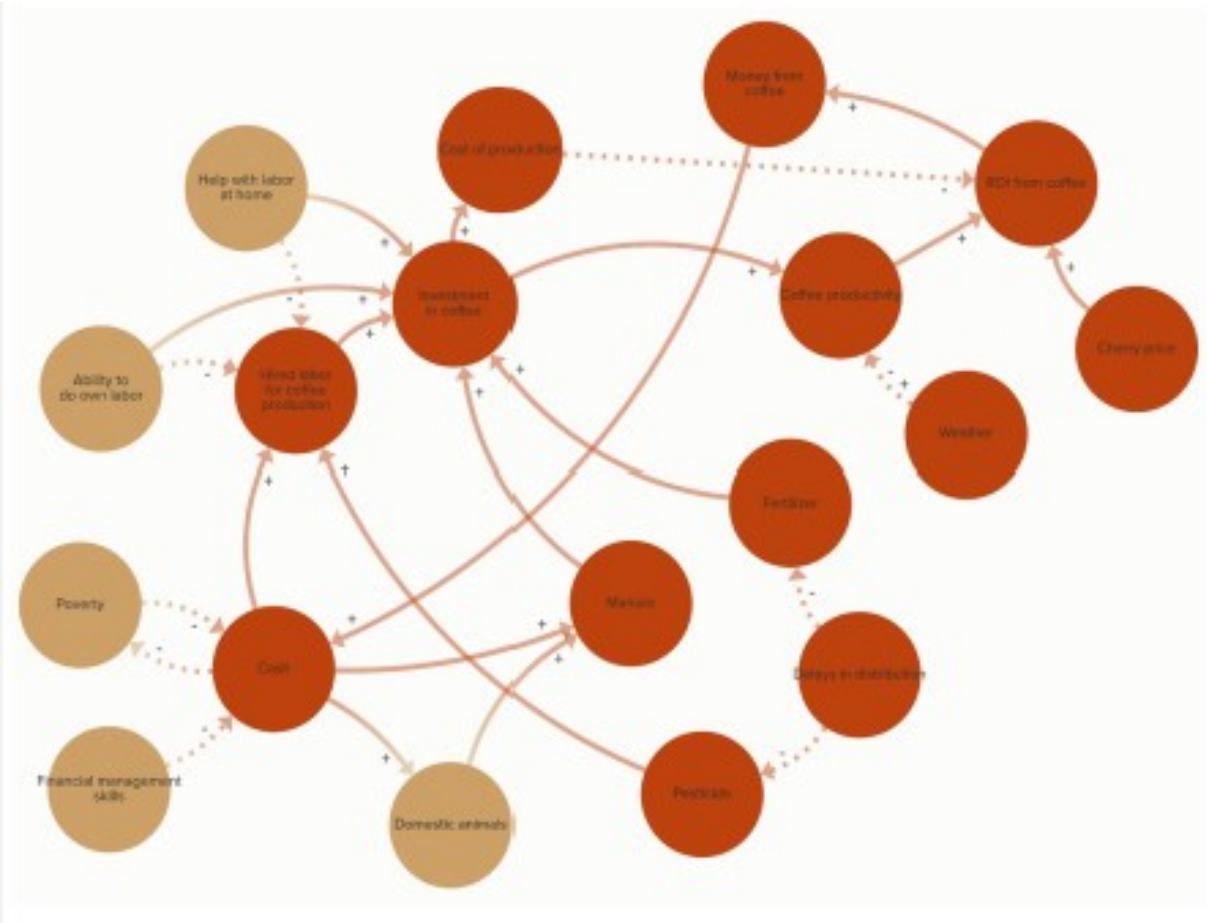
Additional evidence of mistreatment of female HHHs can be seen in both cooperative member and non-member groups. For example, in focus group discussions with both cooperative member and non-member groups, widows said that their in-laws tried to grab their land when their husbands died. Neighbors also tried to claim parts of female HHHs' land. Village leaders often sided with men in these disagreements, although women said that if they can get their case taken up at the district level the officials there treat them more fairly.

Focal problem—Lack of loans: Insufficient loans is a focal problem for one of the cooperative member groups. In figure 4, having sufficient loans allows for the cash to hire laborers and invest in farms. Women in group C2 said that they generally do not earn enough money from coffee to cover expenses through the year, so they take small loans from the cooperative to cover household expenses, which they then pay back out of cherry sales at harvest. This in turn reduces their income from cherry and sets them up to borrow again later in the year.

Participants said that loans that were too small, loan repayment periods that were too short, and that they did not have the right skills for getting loans outside of the cooperative. As one woman said, "If I had larger loans I could manage my coffee plantations well and purchase domestic animals so that they can provide manure to fertilize the coffee trees."

Focal problem—Low ROI for coffee: Women in group C3 blamed high labor costs for reducing their return on investment. They also suggested that a lack of equipment such as pruning shears and machetes reduced their ability to invest, which reduced productivity. Finally, a lack of manure and delays in receiving pesticide and fertilizer reduced investment, which in turn reduced productivity.

Figure 5: Non-member sub-sample mental model diagram



Mental model: Non-cooperative member sub-sample

In figure 5, dark rings remain those elements that apply to both cooperative members and non-members. However, light rings in this case represent elements associated with non-members. In this diagram, investment in coffee, hired labor, and cash remain important. However, the non-member sub-sample emphasized the challenges of poverty, physical weakness, and a lack of inputs in restricting their ability to care for their plantations.

Focal problem—Insufficient labor/lack of help: Two groups of women who were not cooperative members suggested that they had little help with labor at home and, for many

women, little ability to do their own work because of age and physical ailments. As a woman from NM1 noted, beyond physical labor, not having a spouse also means that they do not have help in planning how to solve problems.

> All household burdens are on you as you think about the development of [the] household, because you stand alone for it. This is because we don't have the husbands whom we can think together about the development of the household, and because of that even though you can have many people in the household…some of them think that they are not responsible to think about the development of the household, others are not able to work, and others who are able refuse to work.

As can be seen in figure 4, a lack of labor at home and an inability to do their own labor increase farmers' need to hire labor, while having sufficient cash is required to hire labor.

Two non-cooperative member groups suggested that generalized poverty kept them from hiring labor. When poverty is intense—such as when bad weather destroys other food crops—it restricts not only the ability to hire labor; it can restrict the ability of the household to eat. Discussions of poverty often referenced the Vision 2020 *Umurenge* Program, which disburses services to poor households based on government-set categories (Government of Rwanda, 2007). As a woman in NM3 explained:

> There was a climate change in the past whereby it was reducing the production of crops. We were working for food in the non-governmental organizations which were coming after realizing that that crop production was reduced…Those projects of NGOs are no longer present, and the people who only work and benefit are those ones in the first and the second category of *Ubudehe*[9], where they work and [are] paid by Vision 2020 *Umurenge* Program and buy food. Therefore [for] people who are poor and are classified in the third category of *Ubudehe* it is very difficult to survive.

Non-cooperative member groups also suggested the importance of cash to hiring labor, with causes of a lack of labor including a lack of financial management skills and a lack of manure.

9 Poverty categories applied to families at the local level by village/Cell committees. Ubudehe is a process of using local leaders and citizens to determine how resources are used or, in this case, who is in which category (Government of Rwanda, 2007; Rwanda Governance Board, n.d.).

While the connection between manure, cash, and labor is not obvious, to participants it was clear—having manure means that women can invest in their coffee and other crops and have increased productivity, which in turn means that they will have enough income to hire laborers. This relationship can be seen in figure 5 through the positive connections between nodes for manure, investment in coffee, coffee productivity, return on investment from coffee, money from coffee, cash, and hired labor for coffee production.

Focal problem—Accessing inputs: In figure 5, inputs—manure, pesticide, and fertilizer—were important for investment, which was in turn important for productivity and income.

Beyond contributing to ROI, manure was part of a focal problem for group NM2. Manure must be purchased or farmers must procure domestic animals that can produce manure. Some women have accessed cows through the *Girinka* program (known in English as One Cow per Poor Household) (Paul et al., 2018). However, women must be very poor and win a lottery organized by local leaders to receive cows through this program.

In the mental model, fertilizer has a direct and positive relationship with investment in coffee. For pesticide, because non-cooperative member women hire laborers to spray their coffee, pesticide has a positive relationship with hiring labor for coffee production, which in turn has a positive relationship with investment in coffee. In terms of pesticide and fertilizer distributed by CEPAR, group NM2 said that the primary problem is that they are often delivered late, which reduces their effectiveness.

4.5.3 Potential Solutions

This section presents solutions to problems and causes from problem trees that were discussed during focus groups. While in most cases solutions emerged from focus groups, sometimes a

facilitator would suggest a solution and ask if it might be a helpful approach. In table 13 find solutions for cooperative members and non-members.

Cooperative member solutions

Focal problem—Insufficient labor: The first cause of a lack of labor cooperative members identified was low self-confidence. This involves both negative feelings of women themselves about their value—which some women said are ingrained since childhood—and how society treats them. However, women suggested that being part of a women's association within their cooperative has been helpful. They said that with more resources the association can help them save money, access larger loans, and attend trainings. In addition, cooperatives can continue supporting women by putting them in leadership positions and can publicly showcase successful women. Participants also said that setting personal goals and being successful in meeting these goals increases confidence.

Table 13: Female household head solutions

Problem	Cause	Solution
Cooperative members		
Insufficient labor	Lack of self-confidence keeps women from hiring laborers	Expand women's association work. Groups need more trainers and more money.
		Cooperative puts women in leadership positions
		Women setting and achieving their goals
	Low price for other crops	Financing for smallscale value addition technologies
		Training on value addition
	Lack of cash	Larger loans
		Training on financial management
Lack of loans	Loans are too small	Larger loans
	Repayment of loans in short time periods	Longer time to repay loan and lower interest rate
	Lack of skills to make project proposals	Training on writing loan proposals
Low ROI for coffee	Lack of equipment	Cooperatives purchase tools and provide them as second payments
	High labor costs	Cooperatives advocate for higher farmgate prices

Table 13 (cont'd)

	Lack of manure	Women learn how to make compost
	Delays in getting inputs	CEPAR distributes pesticide and fertilizer earlier in the year
Non-members		
Insufficient labor/ lack of help (combined from groups NM1 and NM3)	Living alone in the household/ must hire labor because they are weak	Form women's group
		Plant mulching materials
	Poverty	Procure domestic animals
		Earn money through small businesses
		Higher farmgate price
	Lack of financial management skills	Training on financial management
	Lack of manure	Learn to compost
		Procure small animals
		Care for other peoples' cows in exchange for manure or for a future calf
		Access cow through genocide survivors' fund
Problems accessing inputs	Lack of domestic animals	CWSs provide second payments in the form of piglets
		CWS holds money for farmers and pays in a lump sum
	Delays in pesticide and fertilizer distribution	CEPAR delivers pesticide and fertilizer on time
		Government provides input vouchers

In reference to the second cause of having insufficient labor—low prices for other crops—cooperative members suggested that financing for value addition technologies and training on value addition could help them increase the income they receive from other crops.

Note that solutions identified for the cause "Lack of cash" (group C1) were similar to those identified for the focal problem "Lack of loans," (group C2) so these are discussed in the following section.

Focal problem—Lack of loans: Most solutions related to improving financing focus on cooperative-based loan programs. The size of loans and brevity of loan periods were discussed as distinct problems but are interconnected and have similar solutions. Group C2 said the maximum

loan available from their cooperative was 30,000 RWF ($32.41 USD as of November 2019) and the maximum repayment period was six months (XE, 2020b). Women were interested in getting larger loans with a longer repayment period and lower interest rates than were available at conventional lenders. They believed that larger loans with longer timeframes should be possible given their close relationships with the cooperative and the relatively low monitoring costs for the cooperative. In addition to larger loans with longer time frames, group members wanted trainings on how to both apply for larger loans and manage their money.

Focal problem—Low ROI for coffee: A lack of equipment affects return on investment via decreased investment and productivity. Women had several solutions to low ROI for coffee.

In discussing high labor costs as a cause of low ROI, participants suggested that a higher farmgate price was necessary to overcome labor costs. They wanted their cooperative to continue advocating for higher farmgate prices. They suggested that for the lack of farming equipment (e.g. machetes, pruning shears, etc.), their cooperative could purchase them in bulk and provide them as second payments.

Access to manure relates to ROI because manure allows for greater productivity via increased investment. Some women had received training from their cooperative on making compost and believed it could be a helpful solution to supplement manure. When asked about cows as a source of manure, women suggested that there is substantial theft where they live, and were afraid that these valuable animals would be stolen.

Finally, delays in pesticide and fertilizer distribution can reduce women's ability to effectively invest in their coffee. Participants hoped that CEPAR could distribute inputs earlier in the season.

Non-member solutions

Focal problem—Insufficient labor/lack of help: Two non-cooperative member groups focused a lack of labor or household help as a barrier to profiting from coffee. A solution these groups discussed was forming a women's association, as exists within the cooperative sub-sample. Such a women's group could allow them to do some of their own labor rather than hiring, pool money to hire laborers, and access funding from NGOs. Along with forming a women's group, women suggested that planting mulching materials could relieve their need to purchase and transport mulching materials, thereby saving them labor.

Two groups suggested that poverty was a barrier to hiring laborers. Discussion of solutions related to poverty largely focused on other avenues of building income, such as improving access to manure and forming small businesses to generate income. Accessing domestic animals would allow for greater investment via manure, which in turn would provide increased coffee productivity, and cash that could be used to hire more laborers. Starting a small business would provide another source of income that could both help women escape poverty and be used to hire labor. Unlike cooperative member groups, non-member groups had limited interest in financing as a way of accessing cash or purchasing domestic animals. They feared defaulting on loans.

Though it was discussed by cooperative member and non-member groups, non-cooperative members specifically identified higher farmgate prices as a solution that could help them get out of poverty. They said that higher farmgate prices, such as the farmgate price of 249 RWF per kilo of cherry set in 2017 ($0.30 USD as of the harvest month of May 2017)—would allow them to cover their expenses and improve coffee investment (The New Times, 2017; XE, 2020a).

Some non-cooperative members believed that accessing financial management training could help them have more cash and hire more labor. They noted that trainings they received in the past from NGOs were helpful in improving farm management.

Non-cooperative members who saw lack of manure as a barrier to hiring labor—because of the importance of manure to coffee productivity and income—said learning how to compost could be helpful. They also suggested that small animals, like pigs or goats, could help in producing manure and are not as expensive as cows. However, some suggested that it might be possible to care for another farmer's cattle in exchange for receiving a calf or to collect pasture for farmers who own cows and then share the manure.

Focal problem—Problems accessing inputs: According to group NM2, the primary barrier to having sufficient manure is a lack of domestic animals. Women were interested in raising goats or pigs because they are cheaper than cows and are easier to maintain on small landholdings. Participants suggested that CWSs could provide a second payment in the form of piglets. Another approach would be to force savings by having CWSs hold farmers' payments for coffee until the end of the season rather than paying in small increments as farmers deliver coffee.

Like cooperative members, group NM2 said that there were delays in pesticide and fertilizer distribution. They suggested that CEPAR could deliver inputs earlier in the season. They also said that for non-coffee crops, the government provided vouchers that gave farmers half-priced inputs that they purchased from agro-dealers. They saw this system as effective, but they appreciated that they do not need to directly pay for coffee pesticide and fertilizer. A possible approach would be for government to provide vouchers that would cover the full cost of inputs, which farmers could then purchase from agro-dealers.

4.5.4 Pesticide and fertilizer access and use

Because input access and use was a motivating issue for this research, we asked all groups about it following discussions of problems, causes, and solutions. Apart from one group that identified lack of inputs as their focal problem (NM2), this discussion was separate from the problem tree exercise. Thus, there are not solutions identified for challenges discussed in this section.

Fertilizer access and use

Both cooperative members and non-members receive fertilizer from local government offices. The volume they receive is based on the 2015 coffee tree census. Fertilizer is not difficult to apply, so both cooperative members and non-members apply it themselves rather than hiring workers.

Women face problems in accessing sufficient volumes of fertilizer, though. Women in four groups (1 cooperative member group and 3 non-member groups) said that they do not get enough fertilizer to cover their plantations, and many women suggested that the coffee tree census is incorrect and that they are not given enough fertilizer for this reason. Some women complained that fertilizer was distributed late by CEPAR, which reduced its effectiveness. Two non-cooperative member groups suggested that local leaders sometimes steal fertilizer, which further reduces the volume available to farmers.

Pesticide access and use

While their experiences in receiving fertilizer are similar, cooperative members and non-members have different experiences in terms of accessing and using pesticide. The cooperative receives pesticide from CEPAR and sends trained teams around to spray farms, which ensures both pesticide access and use for members. The cooperative has communicated to farmers that it is unsafe to have pesticide in their house and that it is better to have professionals spray. The only

problem with pesticide access noted by cooperative members was late delivery by CEPAR. They were happy with the cooperative spraying approach and said that pests were under control.

Most non-cooperative members said that they receive pesticide from coffee cherry collection centers (managed by the CWS), however others said they received pesticide from local government offices or from village leaders. Women learn that pesticide is available from their CWS or local officials and pick up pesticide from these distributors. The women then hire men to spray their coffee.

Most non-members applied pesticides; however, in two groups some women did not spray. Reasons for not spraying included not being able to physically use heavy sprayers and not knowing when pesticide was available. However, beyond the binary of spraying vs. not spraying, participants said that there were delays in receiving pesticide and that they did not receive enough.

Reasons non-members believed they received insufficient pesticide included (1) pesticide being stolen by cherry collection centers or local leaders, (2) not being told when pesticides were available or being refused at the distribution point, and (3) pesticides being diverted to other farmers. One group suggested that women were more likely to be refused than men because distributors thought they could get away with cheating women.

Participants suggested differences in male and females' physical ability to spray pesticide. Five groups (cooperative members and non-members) agreed that women in Rwanda tend not to personally spray pesticides (the sixth group was not asked). Across all groups, only one woman physically sprayed her own coffee. The primary reason for not personally spraying was that sprayers are heavy and female HHHs are often too weak to carry them. In addition, two groups

said that women who are pregnant, nursing, or caring for children must not spray pesticide because it is toxic. Because they do not spray their own coffee, spraying pesticide is a financial expense for many female HHHs, but not necessarily for male HHHs.

4.6 Discussion

According to workshop participants, the biggest barriers facing them in profiting from coffee production are a lack of labor, insufficient financing, and lack of or delayed inputs. These barriers differ based on cooperative membership, however there are commonalities in the experience of female HHHs. For example, labor is a major driver of high costs of production and low investment. Limited household help means that coffee investment requires outlays of cash. Having cash to pay workers is in turn a challenge because of low cherry prices, low prices of other crops, and a lack of assets such as domestic animals that produce manure and can be sold.

For cooperative members, a lack of affordable financing keeps them from making large-scale investments. Most women who were not cooperative members did not want to take loans because they feared defaulting. Because they tend to take loans from their cooperative, cooperative members may be less concerned about drastic repercussions if they default. However, they may also be in a better position to pay off loans than non-members. As was seen in table 11, across Rwanda female cooperative members have nearly three times as many productive coffee trees, over double the annual income, and 60.9 percent more land owned than non-members. While a less stark difference, intake forms for the 2019 workshops suggest that cooperative members had an average of 533.5 coffee trees, while non-members had an average

of 317.0 trees. Both affordability of loans and ownership of assets may influence differences in cooperative members and non-members' interest in loans.

In designing potential solutions, both cooperative members and non-members focused on collective action via women's associations. In the case of cooperative members, this was building on the success of an existing structure; for non-members this was the idea of collectively organizing for the first time.

For cooperative members, more flexible financing options were important solutions. It is unclear the extent to which non-members need access to less restrictive financing sources, or if they need a higher baseline of assets to effectively get financing.

Procuring domestic animals was a solution for three groups (1 cooperative members and 2 non-members). While cooperative members sometimes received them from the cooperative, non-members did not have good ways of accessing animals. Some non-members seemed to view themselves as being in poverty traps, in which gaining additional assets such as animals might push them into a different equilibrium (Barrett & Carter, 2013). Thus, they were intensely focused on accessing domestic animals as a way out of poverty.

Two solutions are outside women's control but were widely discussed: distributing inputs on time and raising farmgate prices. Action on either of these solutions would require government intervention.

An important limitation of this research is that, due to resource constraints, we were unable to share mental model diagrams back with participants for validation. Gaining participant feedback on mental model diagrams would have improved the accuracy of the diagrams and would have allowed participants to use them in decision-making.

4.6.1 Differential impact of input policy on female HHHs

Through focusing on how Rwanda's input distribution affects female HHHs, this study provides insight on gender differences in pesticide use. While problems in fertilizer distribution exist, they are less directly tied to gender because female HHHs can apply their own fertilizer.

Government input policies meant to provide pesticide to all coffee farmers differentially impact female HHHs because of problems in accessing and using pesticide. Beyond the policies themselves, local leaders reduce pesticide access by failing to provide pesticide or providing it in insufficient volumes.

Women who were not cooperative members faced serious challenges in accessing and using pesticide. Based on their input, we can hypothesize answers to a motivating question for this research: why, if all farmers are supposed to receive pesticide, are female HHHs less likely to use it? Reasons for this gender gap may include physical difficulty to spray pesticide and concern about health effects of spraying, possible gender discrimination by distributors, and difficulties in accessing labor. Building on Doss and Morris (2001), this provides an example of women largely (but not completely) having access to an input but not complementary inputs, in this case a way to collect and spray the pesticide..

Female farmers' need to hire laborers to spray their coffee is interesting in light of evidence from other countries that female farmers often hire more labor than male farmers (Peterman et al., 2014). This study suggests that physical inability to conduct some activities may force women to hire labor. However, female HHHs also face barriers to hiring laborers. These include the cash cost of labor and the time, effort, and—given discrimination and sexual harassment—unpleasantness of hiring workers.

4.6.2 Policy recommendations

There are three implications of this research for policy in Rwanda. While qualitative findings are from a small and non-representative sample, in combination with quantitative analysis they can suggest directions that Rwanda's government may take in better supporting female HHHs.

First, qualitative evidence from this study supports findings from studies that Rwandan coffee cooperatives can support farmer wellbeing (Ortega et al., 2019). Rwanda's government should continue to encourage cooperative membership, forming of new cooperatives, and strengthening of existing cooperatives. Cooperatives can facilitate development of women's associations within the overall cooperative structure or the development of new women's cooperatives. Government and NGOs should also consider ways to specifically help non-cooperative female HHHs, who seem to be at a substantial disadvantage.

Second, Rwanda's government should consider how the input distribution system may differentially benefit female and male HHHs. Government can encourage and possibly subsidize CWSs to provide services specifically for female HHHs. CWS owners should also consider creative ways to support women. For example, it may be worthwhile to spray women's farms and collect cherries to improve coffee quality and ensure delivery of cherries. In addition to improving the structure of input distribution, government can evaluate the extent of local diversion of inputs and local discrimination against female HHHs, both of which constrain input use.

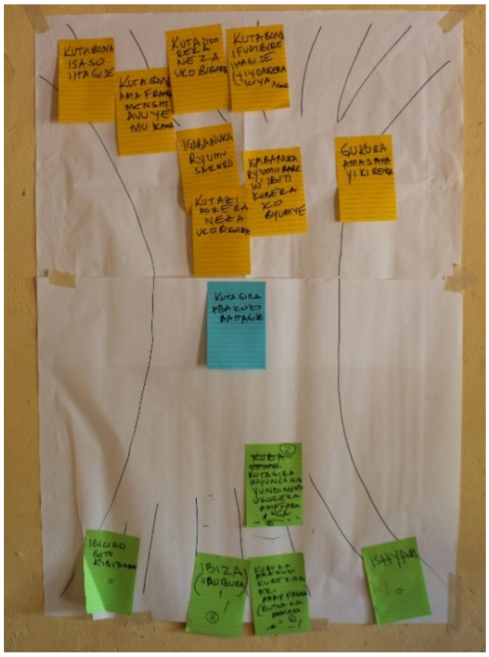
Finally, this study supports previous research which suggests that farmer prices in Rwanda may be too low to allow for long-term investment (Clay et al., 2018). As noted, two workshop groups wanted to have low farmgate prices as their focal problem until we dissuaded them, and the issue

of low farmgate prices came up in all workshops. While this hits female HHHs particularly hard, it is a threat to all farmers and the industry itself and Rwanda's government should continue to ensure that the farmgate price reflects farmer costs of production (Clay et al., 2018).

APPENDICES

APPENDIX A: Example problem tree

Figure 6:Example problem tree from cooperative group



The focal problem is a blue sticky note. The effects are yellow sticky notes. The causes are green sticky notes.

Figure 7: Facilitator helping women vote on top causes of a problem

APPENDIX B: Analysis of identified problems

Workshop participants brainstormed the top problems keeping women from profiting from coffee. A facilitator wrote these on sticky notes and put them on a wall. Participants then discussed and came to consensus on the most important problem.

While most analysis in this chapter focused on groups' focal problem, we also analyzed the full list of problems brainstormed by participants. We developed categories of problems based on emergent themes from across workshops. We then counted the number of groups that brainstormed problems within those categories and the number of discrete problems that groups identified related to those categories. Finally, we counted the number of times discrete problems (e.g. "low farmgate price") came up in workshops.

Table 14: Analysis of identified problems

	Most common categories across groups	**Categories with the most discrete problems associated with them**	**Most common discrete problems**
Cooperative members	**Noted by all 3 groups:** Insufficient farmer investment in plantations, price/return on investment (ROI) **2 groups:** Labor, physical ability/knowledge to farm coffee, theft	Theft (6 problems), labor (5), price/ROI (5), inputs/equipment (5)	**All groups:** Insufficient investment, low farmgate price **2 groups:** Destruction of property, lack of laborers, low coffee productivity, low return on investment, theft of equipment
Non-members	**Noted by all 3 groups:** Inputs/equipment, labor, price/ROI, **2 groups:** CWS management, insufficient farmer investment in plantations, physical ability/knowledge to farm coffee, theft	Inputs/equipment (17 problems), labor (12), physical ability/knowledge to farm coffee (5)	**All groups:** High labor cost **2 groups:** Low farmgate price, low ROI, not getting pesticide/fertilizer, not enough manure, not enough mulch, physical weakness

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CHAPTER 5: CONCLUSIONS

5.1 Scholarly and practical contribution of this research

This dissertation discusses institutional and policy issues constraining Rwanda's coffee sector and the people who work in the sector. In addition—in the case of zoning and pesticide distribution—it describes policies that seems to be effectively improving the sector, though with varying levels of implementation and with some negative externalities. This dissertation contributes to literature about institutional challenges in developing country cash crop value chains, including high costs of information, high costs of contract enforcement, and the potential for hold up by buyers. This dissertation provides insight on different components of Rwanda's coffee sector: from the relationship between different types of exporters, to a policy that affects CWSs and farmers in different ways, to female household heads who face economic, institutional, and cultural challenges. It specifically provides new information on approaches exporters take to overcome transaction costs, the efficacy of local monopsony zoning systems in cash crops, the differential impact of input distribution policies on female household heads, and how female household heads view the problems they face.

This dissertation also contributes methodologically via use of mixed methods approaches. Data collection involved a farmer survey, qualitative key informant interviews, problem trees, and focus groups. Analysis involved qualitative content analysis, development of mental models from problem trees and focus groups, and quasi-experimental quantitative analysis triangulated with key informant interviews. Research papers often involved multiple, iterative stages in which a learning from one stage would inform research design for the subsequent stage. In planning research, I worked closely with Rwandan colleagues in honing research questions and

developing fieldwork approaches and coordinated research with government leaders and industry stakeholders.

While the limited use of quasi-experimental data and Rwanda's often-idiosyncratic context means that these findings have limited external validity, it is important that they are meaningful within Rwanda and Africa's Great Lakes Region. Because of the desire to produce research that is useful to Rwandan stakeholders, it is important to use whatever methods are available to ask policy-relevant questions. However, in joining an existing body of literature, these findings bolster, challenge, or contribute nuance to other findings from developing country cash crop research.

In attempting to balance directly focusing on identified needs in Rwanda's coffee sector and writing relevant scholarly work, I chose qualitative methods to try to answer some practical questions. Post-positivist use of qualitative methods is not common, but is critical for understanding dynamics of problems that cannot easily be studied through survey methods or experiments (Chung, 2000; Poteete, Janssen, & Ostrom, 2010). To increase the internal validity of findings, in both chapters 2 and 4 I used random sampling for qualitative data collective. It is important to provide policymakers and coffee sector stakeholders with confidence that qualitative data is representative in reflecting the views of the sub-population of interest, whether that sub-population is female household heads who sell to a specific CWS or exporters across the sector.

In fact, some research subjects recognized the importance of randomized sampling. A woman in Southern Province asked how her workshop group had been selected, since the women did not know each other and were of diverse ages and varying degrees of health. When told how we

randomly selected them, they clapped. One woman said, “If you had let the cooperative pick who you spoke to, they would have called young and educated farmers, so we appreciate that you picked us.”

5.2 Cross cutting findings and implications of research for Rwandan stakeholders

Three cross cutting findings and implications merit discussion. These include findings on the strength of local policy implementation, the importance of farmer cooperatives, and the need for government support and regulation.

5.2.1 Strength of local policy implementation

Rwanda has developed a reputation for strong governance and policy implementation, and critiques of policy implementation in this dissertation should not be construed as denying that. The policies Rwanda is implementing, such as a national input distribution system, reform of historical land policies, and radically changing how farmers sell their coffee, are bold and difficult to achieve. However, this dissertation does provide examples of national policies that could be better implemented at the local level.

Zoning is discussed in both chapters 2 and 3. Views differ on how well zoning was implemented. Some exporters believed that side selling remained rampant after zoning was implemented. However, analysis of survey data and interviews with CWS managers painted a more positive picture. In both chapters, there is an acknowledgement that the policy is not perfectly implemented and that it harmed some people, largely cooperative members. Harming cooperatives in turn harms female household heads who, as chapter 4 demonstrates, can benefit substantially from cooperative membership.

It is ethically problematic to take away freedom of sale channel choice for farmers and CWSs without their consent. However, given the choice to do so, it is important that it is replaced with something that is clearly better than the status quo. Zoning is not clearly better for all farmers, but it has the potential to be better. Making zoning a clearly beneficial policy will require ensuring that all farmers know about the policy, that cooperative members can still benefit from membership, and that CWSs provide services to farmers in a consistent way.

Like zoning, pesticide and fertilizer distribution is an example of a policy that is largely effective, but has varying levels of implementation at the local level. As noted, input distribution has improved substantially since 2015; this policy is in a broad sense a success. However, a lack of information, corruption, and a lack of money to pay laborers keep female household heads from receiving pesticide at the same rate that male household heads receive it. Cooperatives have made it easier for their members to use pesticide by having professional pesticide sprayers visit their plantations, however for female household heads who are not cooperative members hiring sprayers remains a challenge.

Though less a focus of the dissertation than zoning or input distribution, land reforms have a similar dynamic in that they are bold national policies that are implemented in different ways locally. National policies developed in the past two decades seek to improve land tenure security for women. However, according to focus groups and previous research, village leaders who serve a decision-making role often discriminate against women and adjudicate against them (Jones-Casey, Dick, & Bizoza, 2014).

5.2.2 Farmer cooperatives

All dissertation chapters relate to farmer cooperatives in some way. In chapter 2, some cooperatives owned CWSs and had marketing structures that allowed them to make money. Chapter 3 uncovers a threat to cooperatives, which was that they could be split up and their members could lose access to benefits of membership through zoning. In chapter 4, cooperatives were able to provide farmers a collective action mechanism, provide helpful services such as pesticide spraying, and protect vulnerable members such as female household heads. These papers point to the continued need for government and donors to support cooperatives by government as a means to improve wellbeing of farmers and the functioning of the coffee sector. An important caveat to findings on cooperatives is that in chapters 2 and 4 the cooperatives included were largely known to be strong and well-managed. Given the potential diversity of management capacity in Rwandan cooperatives, there is some risk that these papers overstate the case that cooperatives are helpful to farmers and are competent in terms of organizing exports.

5.2.3 Need for coffee-sector investment and regulation

Previous research has suggested high positive externalities of coffee production, including environmental, economic, and social benefits (Clay & Bizoza, 2018). Given these positive externalities and the economic inefficiencies in the sector discussed in this dissertation, I would contend that the sector needs both investment and creative, careful regulation. The focus on non-coffee crops in recent agricultural policies and loans from multilateral finance institutions may be important from a food security perspective, but Rwanda has a strong comparative advantage in coffee economically and in terms of potential resilience to climate change (Clay & Bizoza, 2018; The World Bank, 2020). The coffee sector requires continued investment, but given pervasive

market inefficiencies and transaction costs it also requires regulation that creates a profitable and equitable playing field for farmers, CWSs, and exporters.

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