Strengthening Agribusiness Ethics, Quality Standards, & ICT Usage in Uganda's Value Chains

AGRI-QUEST

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The Influence of Education, Experience and Access to Credit on the Agricultural Efficiency: A Study in the Ugandan Coffee Industry

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Abstract

Coffee farmers that do not have the right financial- and human resources are less efficient because they are less able to adapt their strategy to changes. Climate change adds pressure to the difficulties that a coffee farmer already feels and cooperatives could positively influence the level of the financial- and human resources of coffee farmers because they are responsible for the distribution of improved farm inputs, training programs, provision of loans and marketing of the coffee beans. Therefore will this research investigate what the influence is of education, experience, and access to credit on the agricultural efficiency of coffee production in Uganda and how this relation is influenced by the role of cooperatives and the perception of climate change.

This research will collect quantitative data and qualitative data will provide supportive information. A survey was conducted to statistically test the relations of the variables and the interviews are used to support the findings of the quantitative survey by providing a more in-depth investigation into the Ugandan coffee production context.

Access to credit from a bank will positively affect the agricultural efficiency of a farmer, in contrary to micro financing institutions and governmental organizations. Perceived climate change has a negative moderating effect on the relation between access to credit from banks and agricultural efficiency and a positive effect on the influence of access to credit from micro financing institutions and governmental organizations on agricultural efficiency. Furthermore, cooperatives negatively moderate the effect of farmers that can easily access credit from friends and family and agricultural efficiency. To enhance the performance of coffee farmers the initiatives must be executed in the right way and at the right time. Cooperatives could play a key role in the accessibility of credit and to communicate knowledge and skills through the coffee value chain.

Introduction

Agriculture is the primary employer for the largest proportion of the Ugandan workforce, with over 70 percent of the Ugandan labor force locked up in this sector. This makes agriculture important for food security in two ways. First, because it produces the food people eat. Second, it provides the primary source of livelihood. The agricultural sector have experienced stagnant productivity growth and its contribution to Uganda's GDP is declining (Byiers et al., 2015). Increased agricultural output is essential for Uganda's economic and social development. Continued expansion of agricultural lands will come at an enormous environmental cost, and any future growth in the sector must come from productivity improvements per unit area (World Bank, 2006). Fortunately, there is considerable room for improved productivity in the sector (MAAIF, 2010).

Coffee remains the major cash crop in agriculture. An unsuitable situation for coffee growers can have great influence on the economic growth and employment of Uganda due to the fact that coffee is the biggest export product of Uganda, representing 20% of the total exports (The Observatory of Economic Complexity, 2014). For that reason will this research focus on the productivity of coffee farmers in particular, which will be measured as the rate of production in yields per hectare and from now on this will be called 'Agricultural efficiency'. Agricultural efficiency is calculated by dividing the total sales of a coffee farmer by the land size used for coffee production.

The difference between actual and technically feasible yields for most crops implies great potential for increasing food and agriculture production through improvements in productivity, even without further advances in technology (Zepeda, 2001). While the importance of physical capital has long been recognized, economic research has identified

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human capital formation as a crucial, productive element of investment, both in its own right and as a complementary input to physical capital and other inputs. Human capital may be embedded in the inputs that go into production or could enhance the way inputs are utilized and combined (Zepeda, 2001). Human capital is an intangible asset, such as knowledge and skills, that can be used to create economic value.

Human capital can be improved by education. Education plays an important role to communicate knowledge and practices and it is an investment in human capital. An investment in general education will raise the capacity to develop and adopt new technologies that will improve the productivity of labor, which will improve the effective use of land. Much knowledge can be transferred by communication, but not all the skills can be transferred theoretically. A part of the human capital is developed by doing-on-the-job. This can be called experience. Those farmers who have more experience in growing varieties will have better access to input markets and those farmers who do less off-farm work tend to be more efficient (Rahman, 2003). An increase in farming experience reduces the risk of crop failure and improves the usage of chemicals to control weed and pests.

Human capital is important to make the right decisions and to implement the changes in the right way, but it is also necessary to have the right financial resources that enable these initiatives. Many farmers are not able to make these investments their selves, which means that they need to access credit to make changes possible. This makes access to credit a key factor in the challenge to improve the efficiency of coffee production. Access to credit is the ability of farmers to obtain financial services or other resources. This can include, credit, deposit, insurance, payments, and other risk management services which enables the farmer to purchase inputs or acquire physical capital.

Coffee farmers that do not have the right financial- and human resources are less efficient and more vulnerable to unintended changes because they are less able to adapt their strategy. External factors add pressure to the difficulties that a coffee farmer already feels (Jassogne et al., 2013). Especially climate change is an important external factor that demands adaptation in strategy, due to the fact that the rising temperatures and the prolonged drought have a catastrophic effect on the crops. In other words, the available resources of coffee farmers, including access to credit, education and experience, determine the agricultural efficiency but the catastrophic effects of climate change affect these relations. The changing climate increases the importance of the presence of these resources among coffee farmers to adapt to necessary strategies.

Nowadays the climate is changing, in some parts of the world this has extreme consequences. One of the most well-known climate phenomena is el Niño and the effects of el Niño are becoming stronger every year. The agricultural production in the low-income developing countries of Africa is harmfully affected by climate change, the livelihoods of many people are at risk and their vulnerability to food insecurity is increased (Dekens et al., 2013). Innovation in the agricultural industry seems crucial for the coffee farmers to overcome climate changes. Farmers can expand their production by innovating autonomously but the right conditions need to be created at higher scales to extend these innovations, underlining the importance of including all stakeholders in research projects (Röling, 2004).

Previous research expects that the resources access to credit, education and experience of farmers will determine the level of agricultural efficiency. Cooperatives could influence the level of these resources because they are responsible for the provision of improved farm inputs, training programs, provision of loans and marketing of the coffee beans (Abebaw & Haile, 2013). A previous study from another

sub Saharan developing country, Ethiopia, found that members of cooperatives sell their agricultural products for higher prices than non-members (Bernard et al., 2008). This means that cooperatives can play a critical role to create the right conditions that will lead to agricultural efficiency by providing extension services, credit, inputs and research (Enzama, 2013).
This research will investigate the influence that access to credit and human capital, in the form of education and experience, could have on agricultural efficiency and how this relation is moderated by perceived climate change and cooperative membership. This leads to the following research question:

What is the influence of education, experience, and access to credit on the agricultural efficiency of coffee production in Uganda and how is this relation influenced by the role of cooperatives and the perception of climate change?

In this study, we explore the conditions at farm level to see whether their agricultural efficiency can be improved to help farmers in Uganda and beyond. Despite various interventions, stimulating and enhancing food security and agribusiness in Uganda, there is still a need to make the value chain players aware, responsive and facilitated to improve their productivity. This study will create more awareness for the importance of agricultural efficiency as a possibility or opportunity to improve the food security and the livelihood of coffee farmers. The awareness is especially important due to the negative effects that climate change could have on the production of coffee. This research further emphasizes the importance of communication of knowledge and skills through the coffee value chain and the key role that cooperatives could play in the communication, but also in the accessibility of credit from different sources.
Overall this research does support the importance of agricultural efficiency. There hasn't been found a significant effect that education and experience affect the agricultural efficiency of a coffee farmer but based on the interviews it seems that there is a relation between the variables. Furthermore, this research does acknowledge the role of access to credit and its influence on agricultural efficiency and it highlights the importance of the source of credit as well. Additionally, this research does contribute in the challenge to the changing climate and it highlights the key role that cooperatives could play to enhance the agricultural efficiency of coffee farmers.

This research is organized as follows. The theoretical framework provides an introduction to agricultural efficiency and how this is related to access to credit, education and experience and how this can be influenced by a changing climate and cooperatives. An overview of the relations between these variables can be found at the end of the theoretical framework in the conceptual model (Figure 2, page 18). In the methods section we explain the research approach, participants, procedure and measurement used to analyze the research question. After the methods section the results from the quantitative and the qualitative research are presented. Finally in the last section we provide a discussion and conclusion of the findings.

Theoretical Framework

Agricultural Efficiency

The agrarian sector in Uganda is characterized by low productivity. This is partly caused by inadequate modern farm inputs, low public and private investment and undeveloped value chains (Chuhan-Pole and Angwafo, 2011). Inadequate modern farm inputs could be the misusage of fertilizers and/or machinery. Given the existing knowledge and technology, for the coffee industry in particular, there is considerable room to increase the productivity without making use of additional inputs (Bravo-Ureta & Pinheiro, 1993). The adoption of new technologies, designed to enhance farm output and income, has received particular attention as a means to accelerate economic development (Hayami & Ruttan, 1985).

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However, output growth is not only determined by technological innovations but also by the efficiency with which available technologies are used (Nishimizu & Page, 1982).

At the moment, many smallholder farm systems in Uganda produce coffee as their major and most important cash crop, yet coffee yields are still poor. To increase farmers' production, a range of agronomic practices has been recommended by national and international agencies (Bongers et al., 2015). The agronomic practices are divided in four main recommendations. First, they want to improve productivity through enhanced coffee management practices, for example pest control by pesticide application. Second, improved soil nutrient management and fertility normally leads to increased productivity. Third, intercropping results into improved productivity, land-use efficiency and sustainability and the last recommendation's aim is to increase revenue through coffee value addition at the farm level (Bongers et al., 2015).

This research will focus on improved productivity in terms of improved land-use efficiency. Coffee farmers have to increase their income from limited land and at the same time they have to reduce their risks related to drought, pest/disease attacks and coffee price volatility (Jassogne et al., 2013). During the decision-making, a coffee farmer considers a trade-off between quality and quantity. New production strategies that can improve the quality of the bean can have consequences for quantity of beans produced. This is still a trade-off, although in the long term a focus on quantity rather than quality is counter-productive. New techniques could lead to increased differentiation of consumption in industrialized economies, a big export market for Ugandan coffee, and at the moment there is an increased demand for high-quality products. The best way to obtain high quality products is to improve the quality standards and reputation in the producing countries (Ponte, 2002). Despite this, a new strategy or a technology will only be implemented when it also has a short-term positive impact on the livelihood of the coffee farmer (Jassogne et al., 2013).

The definition in this research is derived from Battese and Coelli's (1992) definition that states that agricultural efficiency of a farm household refers to: the ratio of its mean production, conditional on its levels of factor inputs and farm effects, to the corresponding mean production if the farm utilized its levels of inputs most efficiently. From now on will 'Agricultural efficiency' in this research refer to the ratio of its mean production, based on the effective usage of land, to the corresponding mean production efficiency of similar coffee farms.

The efficiency of a farm is expressed as the rate of production in yields per hectare. It is measured in terms of gross income based on the coffee production in Arabica and Robusta beans. In Uganda, 80% of the coffee grown is Robusta, and 20% is Arabica coffee. Robusta coffee is grown at altitudes up to 1500 m while Arabica coffee is dominant above this altitude. The total sales in this research refers to the number of Arabica coffee beans produced in kilograms (B) multiplied by the price of Arabica coffee beans (D) plus the number of Robusta coffee beans produced in kilograms (C) multiplied by the price of Robusta coffee beans (E). The agricultural efficiency, in yield per hectares, is calculated by dividing the 'total sales' of a farmer by the total hectares of coffee trees (A). Figure 1 provides an overview of the calculation.

Figure 1. Calculation of Agricultural Efficiency

Agricultural Efficiency	
Hectares of coffee trees	= A
Number of Arabica Coffee Beans produced in kilograms	= B
Number of Robusta Coffee Beans produced in kilograms	= C
Price of Arabica beans per kg	= D
Price of Robusta beans per kg	= E
Total Sales	= (B*D)+(C*E)
Yield per hectare	= Total Sales / A

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Access to Credit

Agricultural efficiency can be improved through enhanced coffee management practices. To enhance coffee management practices, most of the times it is necessary to invest in new equipment, technology or education. Many farmers can't afford these investments without accessing credit from external investors. Credit has long been identified as a crucial factor of farm development. Limited budget has been considered to be an important factor that limits the farms' use of variable and fixed inputs not only in transition and developing countries but also in developed economies (Ciaian et al., 2012).

The level of access to credit is determined by many factors, as farms have various options how to access financial resources. Additionally, market institutions and government interventions could influence the financing options of farms as well. Access to credit is the ability of farmers to obtain financial services or other resources. This can include, credit, deposit, insurance, payments, and other risk management services which enables the farmer to purchase inputs or acquire physical capital. Indirectly this could also contribute to technology adoption and increased capital and input intensity in agriculture (Feder, et al. 1985).

The various options of farmers on how to access financial resources can be distinguished in two forms of financial sources. The formal financial institutions ignore smallholder farmers and small-scale enterprises because their focus is on large-scale, prosperous clients that can satisfy their loan conditions. The government supports the formal sector institutions, which leads to complex and bureaucratic loan application procedures (Germidis et al., 1991). A bank gives a good illustration of a formal financial institution. The informal financial sector provides savings and credit facilities for smallholder farmers and small-scale enterprises both in the urban areas as in the rural areas. In contrary to the formal sector are the application procedures simple and straightforward (Germidis et al., 1991). Major challenges for farmers that want to access credit include unavailability of collateral securities, small loan amounts and delay in the release of agricultural loans. But the main challenge remains the lack of understanding of the loan acquisition process among farmers. (Sulemana & Adjei, 2015).

Informal finance is divers and omnipresent to informal sector economies in Africa and most African entrepreneurs make use of the informal sector. The most common source of finance is from family or friends but in an institutionalized form, such as rotating savings and credit associations, ROSCA (Buckley, 1997). A ROSCA is a group of individuals who contribute a given sum of money that is given to a single member of the group. The ROSCA continues until all members have received the lump sum. It is a form of combined peer-to-peer banking and peer-to-peer lending (Mach et al., 2014).

According to Ciaian et al. (2012), improved access to credit may lead to an increase in productivity caused by scale adjustments of inputs and induced substitution between inputs. Farmers have to take the level of access to credit and disruptions to cash flow into consideration before they implement new practices that will result in higher productivity (IDH, 2013). Although, there are some challenges that make it difficult to make input credit or other financial services available to large numbers of farmers. These challenges include limited experience on the part of banks and weak presence of alternative financial institutions in the rural areas (IDH, 2013).
Technology adoption, increased capital and input intensity may lead to increased production and marketing of high value crops or intensification of livestock production (Pender et al., 2004). In other words, when farmers are able to increase their capital by accessing credit from a certain institution or organization it will lead to increased production, which means a higher agricultural efficiency. When farmers enhance their timely acquisition of production inputs than it would

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enhance productivity as well due to the fact that there is a higher level of efficiency obtained (Pender et al., 2004).

Hypothesis 1. Access to Credit has a positive influence on agricultural efficiency (H1).

Education

As mentioned earlier, enhanced coffee management practices are needed to improve agricultural efficiency (MAAIF, 2010). Education plays an important role to communicate these practices and it is an investment in human capital. Education refers to the process of acquiring knowledge and understanding, regarding coffee production (C.E. Dictionary, 2003). This can be at a school or university but also by an informal training without getting a formal degree. The significant difference with experience is that by education there is someone who is explicitly teaching the farmer how to do his or her business. While in the case of experience the farmer is learning skills their selves by doing it on the job. In this report there is a distinction between education and experience, this section focuses on education and in the next section I will elaborate on experience and its influence on agricultural efficiency.

Human capital directly influences agricultural productivity by affecting the way in which inputs are used and combined by farmers. Improvements in human capital affect acquisition, assimilation and implementation of information and technology. Human capital also affects one's ability to adapt technology to a particular situation or to changing needs (Zepeda, 2001). This means that education, which increases the human capital level of farmers, should lead to a better ability to implement new techniques.

Education may encourage the adoption of new technologies by increasing households' access to information and their ability to adapt to new opportunities (Feder et al., 1985). Nonetheless, educated farmers may be less likely to invest in inputs or labor-intensive land investments and management practices, since the opportunity costs of their labor and capital may be increased by education. This means that that the net impacts of education on agricultural efficiency are ambiguous (Pender et al., 2004). Additionally, some researchers found that the returns to education are low, especially for those who stay in agriculture. The main contribution of education in rural areas appears to be to prepare young people to emigrate to urban areas and cities (Zepeda, 2001).

Earlier efficiency measures, conducted by Bravo-Ureta & Pinheiro (1993), revealed that education, measured either in terms of literacy or years of schooling, had a positive but statistically insignificant effect on productivity. Bravo-Ureta & Pinheiro (1993) concluded that four or more years of formal education were required before increases in productivity could be observed.

Critical elements in achieving increases in labor productivity are the supply of modern industrial inputs in which the new technology is embodied, the investment in general education and in research and extension which raises the capacity to develop and adopt a more productive technology (Hayami & Ruttan, 1970). While the land area per worker remains constant or even declines slightly, the productivity level can still increase when there will be a substantial investment in rural education and in the physical, biological, and social sciences (Hayami & Ruttan, 1970). This is similar to what Zepeda (2001) stated about how human capital also affects the ability of farmers to adapt to new technologies. In other words, an investment in general education will raise the capacity to develop and adopt new technologies that will improve the productivity of labor, which will improve the effective use of land as well.

Hypothesis 2. Education has a positive influence on agricultural efficiency (H2).

Experience

Experience has some similarities with education but the main difference is the source

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of knowledge. Knowledge attained through education could come from theories learned at a school or university through textbooks and teachers. On the contrary, experience attains knowledge from any other source. Experience is a broader concept that consists of both knowledge and skills in a particular job or activity, which you have gained from doing that job or activity (C.E. Dictionary, 2003). For example experience can be attained by doing it on-the-job and is therefore closely related to how many years a farmer is already working in the coffee industry. In this research experience will refer to the accumulated knowledge of practical matters gained by learning on-the-job (C.E. Dictionary, 2003).

Many researchers have recognized the importance of experience for farmers. Rahman (2003) discovered that farmers with more than three years of experience in growing modern varieties earn significantly higher profit, incur less profit-loss and operate at significantly higher level of profit efficiency. Experience in modern rice farming helps farmers to allocate modern inputs effectively, thereby allowing them to operate at higher level of efficiency (Rahman, 2003). Those farmers who have more experience in growing modern varieties will have better access to input markets and those farmers who do less off-farm work tend to be more efficient (Rahman, 2003). An increase in farming experience reduces the risk of crop failure and improves the usage of chemicals to control weed and pests. This results in increased technical efficiency of farmers (Kibirige & Obi, 2015).
Less research has been done in the coffee industry in particular and the influence of experience in coffee production on agricultural efficiency. Bravo-Ureta & Pinheiro (1993) found that the experience of a coffee farmer had a positive impact on the technical efficiency of coffee production. This in combination with the effects of experience in rice and maize farming, both traditional crops like coffee, leads to the following hypothesis.

Hypothesis 3. A high level of experience has a positive influence on agricultural efficiency (H3).

Perceived Climate Change

As stated before, the level of agricultural efficiency is partly determined by access to credit, education, and experience. This means that coffee farmers that do not have these resources are less efficient. Besides its resources, the efficiency of a coffee farmer is also determined by external factors. Climate change is one of those factors and at the moment Uganda is facing some important changes in climate (Dekens et al., 2013). There is an increasing understanding that farmers need to adapt their strategies to a changing climate to be successful. Adaptation strategies have to consider the resource constraints and risk-adverse behavior of smallholder coffee farmers (Jassogne et al., 2013). In other words, the available resources of coffee farmers, including access to credit, education and experience, determine the success of adaptation strategies to climate change. These strategies determine on their turn the agricultural efficiency. Without climate change, smallholder coffee farmers are already vulnerable. Climate change only adds to the pressure a smallholder farmer already feels (Jassogne et al., 2013).

Changing Climatic Conditions in Uganda

Uganda has an equatorial climate, experiencing relatively humid conditions and moderate temperatures throughout the year (Ministry of Finance, Planning and Economic Development, 2009). The climatic conditions vary considerably within Uganda and the three main types of climate found in Uganda are highland, savannah tropical and semi-arid. Traditionally, its climate exhibits two rainy seasons, from March to June and from October to January. A range of broader weather trends and phenomena, e.g. El Niño, influences Uganda's rainfall (Dekens et al., 2013).

Important changes in Uganda's climate variables and hazards are being observed

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(Dekens et al., 2013). The average temperature in semi-arid climates is on the rise, especially in the southwest (MWE, 2002). The country's National Adaptation Program of Action, NAPA, cites an average temperature increase of 0.28° C per decade between 1960 and 2010 (Republic of Uganda, 2007; 2010). Changes in rainfall patterns are also detected. Rainfall has become lower, less reliable and more unevenly distributed (Dekens et al., 2013). Recent years the rainfall seasons were irregular, and rainfalls have been heavier and more intense (Republic of Uganda, 2007; 2010). However, droughts are on the rise. The west, north and northeast of the country have been experiencing more frequent and longer-lasting droughts than in the past (Republic of Uganda, 2007). There have always been droughts in Uganda, but they are becoming more frequent and harsh (Dekens et al., 2013). The most substantial climate-related change in Uganda is the increased frequency and duration of droughts (Republic of Uganda, 2010).

Coffee sensitivity to climate change

The Uganda Coffee Development Authority, UCDA, primarily attributes the high fluctuation of coffee production over the last 40 years to climate variability, together with other factors such as reduced soil fertility and mismanagement (Dekens & Bagamba, 2014). Since coffee trees are shallow-rooted, floods and droughts can affect their growth directly (Dekens et al., 2013). Around Mount-Elgon, in the South-West of Uganda, only Arabica coffee is grown due to its cool climate, while in the Central Region of Uganda, both Robusta and Arabica are grown. Robusta and Arabica have high but differential sensitivity to temperature and rainfall conditions (Jassogne et al., 2013).

A major increase in temperature in the area for coffee agriculture is expected due to climate change (Lane and Jarvis, 2007). An increase in temperature will increase the attacks of coffee pests, which will result in a more vulnerable production of coffee (Jaramillo et al., 2011). In addition, land fragmentation, environmental degradation, poor soil fertility, fake seeds, lack of storage facilities, post-harvest loss, and general mismanagement will also increase the sensitivity of coffee crops due to climate threats (Dekens et al., 2013).

The resources of a coffee farmer determine the level of agricultural efficiency and the ability to adapt their strategy to external factors that could influence their agricultural efficiency. Or more negatively stated, the resource constraints and risk-adverse behavior of smallholder coffee farmers influence or limit the ability of coffee farmers to adapt to external factors, like climate change (Jassogne et al., 2013). Managerial changes and improvements in production require the right financial and human resources. These resources of a coffee farmer become even more important due to the additional pressure of climate change.

Hypothesis 4. Access to credit, Education, and Experience are negatively moderated by perception of climate change on the effect of agricultural efficiency (H4).

Role of Cooperatives

The intensification of agricultural efficiency is achieved through better use of improved farm inputs, such as machinery and fertilizers. This is on their turn achieved through better access to credit to purchase these inputs and through education and experience to optimize the usage of the inputs. Therefore the resources access to credit, education and experience of farmers determine the level of agricultural efficiency. Cooperatives could influence the level of these resources because they are involved in the delivery of different services to their members. These services include, distribution of improved farm inputs, training programs, provision of loans and marketing of the coffee beans (Abebaw & Haile, 2013). A study from another sub Saharan developing country, Ethiopia, found that members of cooperatives receive significantly higher market prices, which leads to higher agricultural efficiency, of farm outputs compared to non-members (Bernard et al., 2008).

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Cooperatives can play a crucial role to improve the agricultural efficiency by providing extension services, credit, inputs and research (Enzama, 2013). This means that cooperatives can influence the accessibility of credit and they try to communicate skills and knowledge through the coffee value chain. An agricultural cooperative is an association of farmers and other rural households who have voluntarily joined together to fulfill a common socio economic objective, mainly increasing income, by undertaking suitable business activities, making contribution to the capital required and accepting fair share of the risks and benefits of the business. (Acharya, 2008). It is the mission of cooperatives, also called unions or associations, to facilitate an increase in quality coffee production, productivity, and consumption.

Prior to 1991, a marketing board centrally controlled the Ugandan coffee market. Coffee producers were organized in cooperatives, and through these cooperatives the marketing board paid farmers a fixed price upon delivery, and a premium based on quality at a later stage. The fixed prices were often below world market levels, and the quality premium was often paid with significant delays. However, this system was liberalized in 1991. Nowadays in Uganda, just like elsewhere in developing countries, cooperatives are valuable for smallholder access to input and product markets. Collective action reduces transaction costs and limit risks of investment and transaction failures for smallholder food producers. The structure of cooperative, types of goods and services they deal in have influence on the performance of cooperatives. Whereas cooperatives are valuable for transaction cost reduction, their capacity to do so is weak in an unstable institutional environment in which cooperative activities and organization are embedded. The fact that smallholders also do act opportunistically should not be underestimated in contractual relationships (Enzama, 2013).

The Uganda Coffee Development Authority (UCDA) was established as a public authority and its directive is to promote and oversee the coffee industry by supporting research, promoting production, controlling the quality and improving the marketing of coffee in order to optimize foreign exchange earnings for the country and income of the farmers. The UCDA wants to achieve a sustainable coffee industry with high stakeholder value for social economic transformation and their mission is to facilitate an increase in quality coffee production, productivity, and consumption (MAAIF, 2013).

Cooperatives aim at making change for their members and community. The activities of cooperatives are meant to have positive influence on the income level, public services, jobs and general increase in the stock of knowledge and skills (Okello et al., 2013). Although, most Ugandan farmers still operate on individual basis, a situation that limits coffee aggregation for collective processing and marketing. To increase their income, farmers need to participate in all the stages of the value chain, influencing all decision making process affecting the coffee industry, such as the processing and marketing of coffee. Farmers that do not participate in cooperatives can hardly influence the coffee policy (MAAIF, 2013).

Hypothesis 5. Access to credit, Education, and Experience are positively moderated by cooperative membership on the effect of agricultural efficiency (H5).

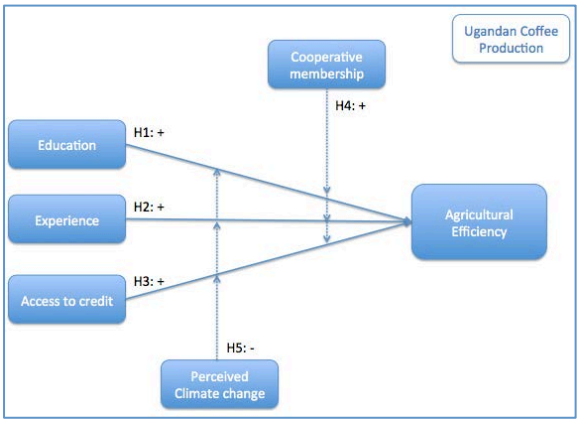

Figure 2. The conceptual model

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METHODS

Research approach

In this section the used methodology is described. A description of the approach, measures and procedures has been included. In this study we use a mixed method. The last years the number of researchers that have been using mixed-methods designs to inform their research increased (Ivankova et al., 2006). The mixed method is a procedure for collecting, analyzing, and integrating both quantitative and qualitative data at some stage of the research process within a single study for the purpose of gaining a better understanding of the research problem from one research tool to the other (Ivankova et al., 2006). Mixing means either that the qualitative and quantitative data are actually merged on one end of the continuum, kept separate on the other end of the continuum, or combined in some way between these two extremes (Creswell, 2009). In this research we collect quantitative data and qualitative data will provide supportive information. The survey was used to test some relations and to draw conclusions and the interviews are used to support the findings of the quantitative survey by providing a more in-depth investigation into the Ugandan coffee production context. The combination of such an approach gives the opportunity to illustrate conclusions from the quantitative study with the qualitative results. An illustration can give a clear view on what a relationship truly means and what kind of consequences it can have in a specific context.

This means that the data is collected and analyzed in a chronological way. In this research there is a strong focus on the quantitative data, so we make use of the sequential explanatory strategy. This method collects and analyzes quantitative data in the first phase of research followed by qualitative data in the second phase. The data is mixed when the initial quantitative results informs the secondary qualitative data collection (Creswell, 2009). In other words, the two sources of data are separated but connected. The direct nature of this strategy is one of its main strengths. It is easy to implement because the steps fall into clear, separate stages. Additionally, this design makes it easy to describe and to report. The main weakness of this design is the length of time involved in data collection, caused by the two separate phases (Creswell, 2009).

Participants

Quantitative Sample

This research wants to draw causal generalizations to a broader population of people, observations, and settings than included in this particular study. This is only possible when the sample size is big enough, in this case there will be 100 reliable respondents necessary to draw a reliable conclusion. To make sure that there will be sufficient reliable respondents the sample group must be carefully selected. Because the focus of this research is on agricultural efficiency, in terms of effective land-use, only Ugandan coffee farmers will be selected because the farmers are actually involved in the production of coffee.

The sample is divided into three subgroups that represent a different region of coffee production in Uganda. This allows the research to measure if there will be a different effect for each region or the type of coffee that is produced. For example, Robusta coffee is grown at altitudes up to 1500 m while Arabica coffee is dominant above this altitude. Due to the raising temperatures, caused by a changing climate, the altitude threshold will move up hundreds of meters. Which can have a bigger impact for Arabica coffee farmers.

In this research the total sample consists of 106 respondents. The sample is divided into 32 farmers from Luweero, 15 farmers from Mbale and 58 from Bugiri. The majority (n=78) is not associated with a cooperative and 88 of the respondents are men. Of the respondents went 41 just to primary school and 41 to secondary school. For only six respondents was tertiary school the highest completed level of school and nine of the respondents even went to University.

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Qualitative Sample

For the qualitative part of the research we conducted fourteen interviews among different stakeholders in the coffee value chain of Uganda, an overview of the interviewees can be found in the appendix (Table 10). To make sure that the data would give in-depth information that could provide some supportive information we selected not only farmers but also authorities, for example the UCDA, traders, and other researchers. The farmers were especially valuable because they can illustrate the findings we gahthered through the survey. Other stakeholders can give further insights in how the current situation is originated, for example an agricultural researcher. As one interviewee explained: *'If you want to intensify, you will get higher efficiency rates. But only if you follow the right steps and in the right sequence. Many farmers start with the usage of fertilizers when their pruning isn't good enough yet. So first you need a good base before you can make further steps in intensifying your production'.*

In total, the group of selected interviewees consists of two coffee farmers, two coffee traders, four board members from different authorities, four employees or managers from agricultural related organizations, and two researchers specialized in coffee production. The qualitative data will it be used to illustrate and explain the statistical findings, the most relevant quotes of the interviews can be found in the appendix (Table 11-16).

Procedure

The data is collected during a field trip in Uganda, with support of a lecturer from the Makerere University in Kampala. With this help we conducted interviews with farmers, researchers and the relevant representatives of the government and NGO's. Most of the interviews were conducted in Kampala because many authorities, traders and NGO's are situated in the capital of Uganda.

During a field trip to Mbale and its surroundings we conducted several interviews with different stakeholders along the coffee value chain by going to an agricultural convention for conservation of agriculture principles and by visiting farmers on their farm. This gave us a better understanding of the context and conditions they are working in. Additionally, we conducted 15 survey responses from coffee farmers in and around Mbale.

We also cooperated with two regional coffee farm coordinators, in Bugiri and Luweero, that were willing to translate and distribute our survey and to conduct the survey with the local farmers that were not able to read or write. Due to the fact that many coffee farmers are not able to read or write, we decided to keep the survey simple and short so that the coffee farmers could understand the survey and won't lose their attention. Especially a focus was placed on the fact that the farm coordinators could clearly explain the questions to the coffee farmers to avoid miscommunication and losses in translation. For that reason the survey was completely structured with mostly closed-ended questions. Except from the questions that were related to the quantity of the coffee beans produced and its price were all the questions formed as a checklist with Likert scales so that the respondents only had to tick boxes to keep the survey as simple and clear possible.

To get deeper insights related to the survey we made use of the interview guide approach. The topics were prespecified and listed on an interview protocol so that some questions were asked every time to measure different opinions and insights from different stakeholders. However, the questions could be reworded as needed and we could ask the questions in any sequence order. This gave us the opportunity to go deeper into topics the interviewee mentioned and to get a clear idea of the situation the interviewee describes.

Measurement

There are three main independent variables that are explained in the conceptual model, two moderators and one dependent variable. To test the relation between these variables

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we also made use of three control variables (Region, Age, Gender) to exclude other possible explanations for this relationship. For the quantitative part are all the variables conducted in a survey and the answers were coded in a way that it could be used for calculations and measurements. For example the variable 'Training Received' is measured in the following way: Question 26 of the survey was: *Have you ever received training in coffee production?* The answer possibilities were on a scale from 'Strongly Disagree' to 'Strongly Agree' where 'Strongly Disagree' is coded as 1 and 'Strongly Agree' as 5. A full table (Table 1, Appendix) of all the variables can be found in the appendix where we explain how the variables and results are collected and coded, and an example of an illustrative quote of the interviews is given as well to give an example of these variables are mentioned during the interviews.

RESULTS

Data Preparation, Reliability and Validity

In this section the results from the collected data will be presented, but before we could use the dataset we had to do some preparations and check the reliability and validity of the results, to make sure that the results are valuable and insightful. We started to check the dataset on outliers. Two farmers didn't produce coffee for the last year, for that reason we decided to remove them from the data. Due to the fact that we had 106 respondents, we will stay above the minimum of 100 (n=104) to conduct a reliable research.

In the survey the perceived climate change is measured in five different questions that measure different aspects of climate change in Uganda, these measurements are based on the findings of Jassogne et al. (2013): Prolonged drought, heavier rains, rain distribution, amount of rain in wet season, and level of adaptation to climate change. To test the reliability of the outcomes we conducted a Cronbach α on these five questions. The Cronbach α was 39,1% (Table 2, Appendix) which is relatively low but when we deleted question two, that measures the gradation of rain, we obtained higher Cronbach α of 53,2% (Table 3, Appendix). For the other variables there isn't any need to conduct the Cronbach α test because the questions stand on their own.

To test the reliability and validity of the moderation effect of hypothesis 4 and 5, we had to take the VIF-scores and Tolerance scores into account. These scores are necessary to assume if there is a possibility of multicollinearity of the variables. The VIF scores of the interaction effects are above the threshold of 10 (Table 4, Appendix) and the Tolerance scores of these interaction effects are below 0,10 (Table 4, Appendix). This is not extraordinary because the interaction effects are based on two other variables that are also included in the regression analysis. The independent variables score below VIF threshold and above the Tolerance threshold and therefore a possibility of multicollinearity of the variables can be excluded (Sekaran & Bougie, 2010). A further explanation of the interaction effect variables will be given in the section related to the testing of hypothesis 4 and 5.

Hypothesis testing

For the quantitative part of the study, the first three hypotheses were tested in a hierarchical multiple regression. First of all, the control variables were added to the model in the same time to exclude the possibility of different explanations for the occurrence of the dependent variable. Thereafter the independent variables were added to the model, one by one, to test their single influence on agricultural efficiency. Unfortunately there isn't any significant relation between the variables when it is tested one by one. For that reason we decided to also make use of the standard multiple regression method where we added all the variables to the model in the same time (Model 31 – Table 8, Appendix). This is less reliable but still gives a good indication of the relation between different variables.

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The first hypothesis, *Access to Credit has a positive influence on agricultural efficiency,* is tested for five different forms of credit suppliers so that the different suppliers do not influence the outcomes of other suppliers. Besides that, it also allows this study to test the differences between different forms of credit. The five different forms are: credit from friends, family, banks, micro financing institutions, and governmental organizations. To increase the significance level of the results, we decided to combine credit from friends and family. Therefore we computed a new variable 'Access to Credit - Friends & Family', which is a mean of the former two variables.

First, the control variables were tested on their influence on agricultural efficiency. The control variables had a significant effect and explained 19.8% (R^2 = 0,198; Table 9, Appendix) on the variance of agricultural efficiency. Among the control factors only region had a significant influence on agricultural efficiency (p = 0,000; β = - 0,388; Table 8; Model 1, Appendix), which means that the eastern regions, Mbale and Bugiri, are less agricultural efficient than Luweero.

Thereafter hypothesis one, two and three were tested. On the first hypothesis the results show that there was significant positive effect between a high level of access to credit from banks and agricultural efficiency (p = 0,000; β = 0,802; Table 8; Model 31, Appendix) and a negative effect of access to credit by micro financing institutions (p = 0,004; β = - 0,452; Table 8; Model 31, Appendix) and governmental organizations on agricultural efficiency (p = 0,006; β = - 0,445; Table 8; Model 31, Appendix). These results partially confirm the first hypothesis, because a high level of access to credit from banks positively affects the agricultural efficiency of coffee farmers. However the results also state that access to credit from micro financing institutions and governmental organizations negatively affect the agricultural efficiency of coffee farmers, which is in contrast with the first hypothesis.

The second hypothesis was tested, in the same model as the first hypothesis (Table 8; Model 31, Appendix), on four different aspects of education. First, the highest school level they have attended, second the amount of years they went to school, third the gradation of specific coffee production education and the last aspect is the gradation of specific training in coffee production they have had. The hypothesis that is tested states that: *education has a positive influence on agricultural efficiency.* In the results there hasn't been found a significant relation, which means that there is nothing to say about the relation between education and agricultural efficiency based on the quantitative data of this research. Unfortunately the same is the case for the third hypothesis that states: *A high level of experience would have a positive influence on agricultural efficiency.* This means that the first hypothesis is partly accepted and that the second and third hypotheses are rejected.

Moderation effects

For the fourth and fifth hypotheses the possible moderating effect of perceived climate change and cooperative membership were tested in a hierarchical multiple regression, in which the independent variables and moderators were added to the model in multiple steps to discover their additional explained variance of the dependent variable.

In the first step the dependent variable 'agricultural efficiency', in yield per hectares, was regressed on the control variables region, age and gender to exclude possible confounding relations. Subsequently, access to credit, education and experience were added to the model in the second step and perceived climate change was entered in step three. To test the moderating effect of cooperative membership the same procedure was followed, only in step three was perceived climate change replaced by cooperative membership.

To test the moderating effect it also necessary to create new variables that measures the interaction effects between the independent

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effects and the moderator, for example the interaction effect between the school level and the membership of a cooperative (Table 8; Model 24, Appendix). All the interaction effects were also tested one by one and at the end in one final model (Table 8; Model 32, Appendix). As well as for the first three hypotheses, there isn't any significant relation found between the interaction effects and agricultural efficiency, when tested one by one. But in the final model (Table 8; Model 32, Appendix) a moderating effect has been found (p = 0,000; R^2 = 0,746; Table 9, Appendix) which is significantly caused by perceived climate change that influences the relation between agricultural efficiency and: access to credit from Banks (p = 0,000; β = 7,768; Table 8; Model 32, Appendix), access to credit from micro financing institutions (p = 0,000; β = -2,997; Table 8; Model 32, Appendix), and access to credit from governmental organizations institutions (p = 0,000; β = -4,685; Table 8; Model 32, Appendix).

The same procedure has been followed to test the moderating effect of cooperative membership. There has only been found one significant relationship that cooperatives negatively moderates the effect of access to credit from friends & family on the agricultural efficiency of coffee farmers (p = 0,007; β = -0,701; Table 8; Model 32, Appendix).

Interviews

The interviews will be used to strengthen the validity of these results and to give the generalized results deeper insights. The interviews were analyzed and then compared to the results of the quantitative study. This can mean that some results will be in line with the quantitative data and can give an additional explanation to the causation of the relationship and some qualitative results will be contradictory. The most important findings of the interviews will be discussed in this section and the discussion and conclusion that will follow from these findings will be discussed afterwards.

Agricultural Efficiency

Productivity is an important discussion for many farmers and authorities at the moment. This is caused by different reasons but many of the interviewees mention that productivity is especially important to increase the income of their family and to improve their livelihood. For example James Ssemwanga, '*When you get better returns of investments you will keep investing in productivity enhancing technologies. Ideally this should make you more competitive. Which has to lead to better food security'.* That the current productivity level is a problem and that it must improve is clearly mentioned by Piet van Asten '*When we look at the amount of hours a farmer has to work to get a certain output, many farmers are making loss. The coffee farming industry is too labor-intensive for the yield it provides.'*

That productivity has to increase is recognized by more stakeholders. This can be achieved in many ways but improved management is one of the solutions according to researcher Arthur Wasukira '*We are looking at improving the yields of coffee and that will result in an increase of income. Coffee has been a neglected crop with reduced management. Our main intervention there is on the management of the coffee'.* Arthur Wasukira explains that they try to improve coffee management by education and trainings: '*We also do business development trainings, mainly to the farmers. Access to information is one of the biggest challenges. If you don't know, it is hard to adapt'.* But just researchers and authorities mainly recognize the importance of improved productivity. In contrary a smallholder coffee farmer *(*Michael Kijjambu) said: *I think one of the ways to increase productivity is to increase the price. Of course there are other factors but price is a key factor*'. In other words, he thinks that productivity is simply achieved by selling for better prices. He has no idea how an increase in these prices is attained.

Cooperatives could improve the awareness and knowledge of farmers to increase productivity. '*Farmers who are connected to an association are more aware of course regarding sustainability, because they receive*

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training, they know how to use fertilizers' (Moses Makaka). Also the effect that climate change can have on agricultural efficiency is recognized. '*This year the yield was low because the weeding and the rain weren't good last year. I lost half of the yield because my land is affected by too much drought. The growth is stagnated the last years' (*Mutwalibi Galugali). More quotes that are related to agricultural efficiency can be found in table 11 of the Appendix.

Access to Credit

Before I will go deeper into improved coffee management, I will focus on the first variable 'Access to Credit'. Sarah Mubiru states that it is not easy to access credit for the following reason: *'… first of all the interest rates are very high. I think that at the moment they are around 24% and they need a mortgage, like their houses or trucks. And when you have nothing to put in, you can't get anything'.* Piet van Asten mentions another important finding. He thinks that even less than 20% of the farmers access credit from formal institutions and that most of it comes in informal and semi-formal ways which leads to other problems *'Most of the times the intake sessions is not that strict which leads to a high failure percentage of the investment'* (Piet van Asten).

Because it is hard to access credit from formal institutions, many farmers create other possibilities. For example **'***many people created their own understanding, like communities in villages, they collect money and they lend it to one person. When that person pays back, they maybe lend it to someone else. This can be done with or without interest. Or at the end of a season they all collect a certain amount and give it to one person……Also the unions that are localized in communities are helpful, because they are easier in lending. They lend out very small amounts of money. For a big investment you still need a bank. Unfortunately people use their savings and run away with their saving and leave the others with nothing' (*Sarah Mubiru).

When farmers are not able to access credit, it also leads to other problems because they can't adapt to climate changes because they can't afford the adaptation methods. '*Now, the problem here, most of the coffee farmers are self-sponsored, they are not government-sponsored. So when they are affected by drought, you have to face it yourself. So, most of the farmers cannot afford to irrigate' (*Seguya Yassin). In the appendix a full table (Table 12, Appendix) of all the quotes related to access to credit could be found.

Education

As mentioned before, improved coffee management can lead to improved agricultural efficiency. Authorities and associations promote better management by giving education and trainings. For example Deus Nuwagaba from NUCAFE, the National Coffee Union, *'Normally, we have the farmers training and education, this is number one to build capacity'* and Fred Tabalamule '*Yes increasing efficiency, ….. and they train other members of that community in practices and technologies and also provide knowledge regarding climate control and changes.'.* Smallholder coffee farmers' also recognize this: '*the trainings always help us a lot. When they train you, you get a good yield of coffee because they teach you how to produce good quality' (*Frederik Kawanga).

On the other side, training doesn't always lead to improved agricultural efficiency. Training has to be done in the right way and at the right time '*Sometimes after a training we visit the coffee farmer and then we figure out that he has sold his coffee in an earlier stage for a lower price. At that moment he chose to have a guaranteed income above a better price at a later stage'* (Piet van Asten). *'If you want to intensify, you will get higher efficiency rates. But only if you follow the right steps and in the right sequence….. So first you need a good base before you can make further steps in intensifying your production'* (Piet van Asten). So the level of training is as well something that has to be taken into account. More quotes that are related to education and training are

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summarized in the appendix in table 13.

Experience

Skills are obtained by doing on the job, or in other words experience leads to better skills. Good education and training normally leads to improved skills as well. This is also the case for many farmers '*the trainings always help us a lot. When they train you, you get a good yield of coffee because they teach you how to produce good quality. Actually, even during the harvest they teach you how to grade the good quality bean and also those that are not good. So they give us the necessary skills and knowledge' (*Frederik Kawanga). The importance of experience is also recognized by Apollo Segawa, an incubator from the Makerere University '*So studies are quite theoretical, or most of them are still like that. We are now trying to spread ahead the issue of ensuring that the curriculum reaches to enterprise development'*

On the other side, experience can also have some negative effects. One of them is that older farmers are stuck in their old habits. '*That is a big challenge, changing the culture. Most of the farmers are quite old. It is good now we are seeing more young farmers. We have started this young farmers' association. The young, more energetic better educated Ugandans so they can become farmers' (*Michael Kijjambu). This is also mentioned in relation to the adaptation to climate change: '*The farmers actually don't know much about the climate change and everything. They know the traditional seasons. So all the farmers, even the coffee farmers, for example during November and December, we don't expect a lot of coffee harvesting. But there was a time when there was too much rain, and they harvested it, the coffee plants didn't have any beans inside' (*Apollo Segawa). More quotes related to experience can be found in table 14 (Appendix).

DISCUSSION & CONCLUSION

This research investigated the influence of education, experience, and access to credit on the agricultural efficiency of coffee production in Uganda. Agricultural efficiency leads to an important discussion, at the moment, among different stakeholders in the coffee value chain. The efficiency level has to increase with use of a limited input. This means that the production process must be enhanced to improve the quantity and quality of the coffee beans. The quality of the beans can be improved in several ways, but this research focused on the human capital factors like education and experience that should lead to improved quality, and a premium price, and the access to credit that make necessary investments possible.

The interviews showed that agricultural efficiency is an important topic at the moment but mainly 'well-educated' researchers and authorities recognize this. '*When we look at the amount of hours a farmer has to work to get a certain output, many farmers are making loss. The coffee farming industry is too labor-intensive for the yield it provides'* (Piet van Asten). This confirms the statement of Chuhan-Pole and Angwafo (2011) that the agrarian sector in Uganda is characterized by low productivity. The importance of agricultural efficiency keeps rising due to the current climate change. The climate change influences the quality of the coffee beans, which will have consequences for the export market, because it becomes harder to meet the quality standards of importing countries. Another thing that is important to notice is that among the coffee farmers there is less awareness to climate change and to the importance to increase their agricultural efficiency then compared to researchers and authorities.

Credit has long been identified as a crucial factor of farm development. Limited budget has been considered to be an important factor that limits the farms' use of variable and fixed inputs (Ciaian et al., 2012). In the quantitative part of the study there has been found that when a farmer can easily access credit from a bank it will positively affect his agricultural efficiency. The opposite is the case for coffee farmers that can easily access micro financing

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institutions and governmental organizations. This means that not just budget is a critical factor but that the situation is more complicated. Even the way the budget is obtained determines the effect on agricultural efficiency.

The means of the different sources of access to credit (Table 5, Appendix) show that credit from friends and family is the easiest to access and between the other three sources there isn't much difference. So the easiness of accessing credit doesn't give an explanation to the positive and negative effects of access to credit from banks, micro financing institutions and governmental organizations. So probably the accessibility of credit isn't the factor, but it could be affected by the intake requirements of the different sources that influence the agricultural efficiency. The strictness of these requirements determines if a business, in this case a coffee farmer, is viable enough for the investment it needs. Further research must be done to secure this and to give a deeper, specific explanation. But from these results, it seems to me that too strict or bureaucratic requirements, like governmental organizations, are too complex for many farmers and too flexible requirements, from friends and family but also from semi-formal micro financing institutions, lead to a high failure percentage of the investment. Another explanation could be the size of the loan. Can a small loan from friends and family or from a micro financing institutions make enough difference or is one big investment necessary to make some real improvements? This is also something that future researchers should look at.

Additionally, perceived climate change puts more pressure on the relation between access to credit from banks and agricultural efficiency and its positively affects the relation between access to credit from micro financing institutions and governmental organizations and agricultural efficiency. This implies that the changing climate will increase the importance of the source of credit. Furthermore, cooperatives negatively moderate the effect of farmers that can easily access credit from friends and family and agricultural efficiency. This shows that also for members of cooperatives the situation is not ideal yet.

According to Zepeda (2001) human capital directly influences agricultural productivity because it affects the way in which inputs are used and combined by farmers. Furthermore, it also affects one's ability to adapt technology to a particular situation or to changing needs. From the quantitative results there hasn't been found significant results about the role of education and experience but the qualitative results confirm the importance of communication of knowledge and skills through the coffee value chain. In most of the situations they try to do this by education or training. Currently, this is mainly done by cooperatives, but even the cooperatives sometimes have a simple or lack of knowledge and understanding of production methods and quality standards. '*The coffee regulations in producing the beans is that you only pick out the ripe one. Then there's also a policy on, like I said, you pick only the ripe one and pulp it on the same day, and then you follow with the drying process. That's the process.*' (Nathan Mabonga, board member of a cooperative).

For that reason it is important that NGO's, governmental organizations, or universities keep developing training programs and other methods of support. This knowledge could be communicated by education or training through the value chain. Cooperatives could form a good combination with these organizations because the organizations have the knowledge and skills and the cooperatives have the network to share the knowledge in a social environment. Further research could elaborate on the best way to do this, but it seems to me that it is important to communicate specific agricultural knowledge, to avoid a loss of well-educated people that choose to move to the city.

Improved coffee management is a solution that is mentioned several times to increase the efficiency level. To enhance the performance of coffee farmers the initiatives, that increase

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the skills and knowledge of farmers, must be executed in the right way and at the right time. Not all the farmers are in the same stage of knowledge and skills, so it is important to know which farmer is qualified for that specific initiative. An important role can be played by cooperatives, by mapping all the farmers. Cooperatives are closer to the farmer and they can better track the performances of the farmers. At the moment the majority of the farmers aren't related to a cooperative, so if you want to reach most of the farmers the cooperatives have to recruit more members. Due to the history many farmers distrust the cooperatives. So if cooperatives want to enlarge their reach they have to invest in trust building and they have to convince farmers of the added value of a membership, this can be done by showing concrete results. Further research should elaborate on this.

Important to take into account is that the level of education is perceived differently per person. For example, one coffee farmer had the feeling that he was well trained due to the fact that he knew how to treat an affected plant, in contrast to researchers that already talk about training programs in the agribusiness. Furthermore, communication does play an important role to the challenge to change the status quo and to create a new agribusiness way of thinking. This also applies to the older, more experienced, farmers that can be stuck in their old habits. This means that experience could lead to inefficient production methods, in contrary to Rahman (2003), and Kibirige and Obi (2015) that stated that experienced farmers should lead to higher agricultural efficiency.

As mentioned a couple of times, communication could play a key role in the dissemination of knowledge and skills. Cooperatives could stimulate this and also support the accessibility of credit from different sources. A cooperative could bring farmers together where they can share their ideas and solutions to problems and their collaboration can lead to bargaining power, for example in negotiations on prices with buyers. On the other hand, cooperatives negatively moderate the relation between access to credit from friends and family and agricultural efficiency. A reason could be that friends and family don't see the necessity to lend money due to the fact that the farmer is already part of another community that should give him better access to credit. But this is also something that further research must elaborate on.

Overall the importance of agricultural efficiency is supported. We cannot claim that education and experience affect the agricultural efficiency of a coffee farmer but based on the interviews it seems that there is relation between the variables. Furthermore, this research does acknowledge the role of access to credit and its influence on agricultural efficiency and it highlights the importance of the source of credit as well. This is something that is not particularly mentioned in previous research. Additionally, this research does contribute in the challenge to the changing climate by showing hard data to prove the impact of climate change on coffee production. According to Piet van Asten this is hard needed to create awareness among regional decision makers. It also recognized that the regions Mbale and Bugiri are less agricultural efficient as Luweero, which could be caused by the altitude of the region. There is a possibility that Mbale en Bugiri are less efficient regions because they face bigger consequences of the changing climate due to their higher altitude, and therefore have problems to keep producing Arabica coffee beans.

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APPENDIX

Table 1 – Measurement and Quotes

Variable	Measurement	Quote
Region	1 = Rwenzori; 2 = Luweero; 3 = Mbale; 4 = Bugiri	*' the more we have an increase in temperature, we are highly likely to have the robusta at a big disadvantage. Though the arabica zones will be more vulnerable to pests and diseases. The two zones of coffee have different diseases.'(Deus Nuwagaba – NUCAFE).*
Age	1= younger than 18 years; 2= 18-25 year; 3= 26-35 year; 4= 36-45 year; 5= more than 45 years old	*'Most of the farmers are quite old. It is good now we are seeing more young farmers.' (Michael Kijjambu)*
Gender	Gender: 0 = Female; 1= Male	*'The coffee and cocoa business are dominated by men. For the main reason because the crops are cash crops.'(Piet van Asten)*
Access to Credit	0= Not Applicable; 1 = Hard; 5= Extremely Easy	*'That is not easy, first of all the interest rates are very high. I think that at the moment they are around 24% and they need a mortgage, like their houses or trucks. And when you have nothing to put in, you can't get anything. So many people created their own understanding, like communities in villages, they collect money and they lend it to one person. When that person pays back, they maybe lend it to someone else.' (Sarah Mubiru)*
School Level	0 = Not Applicable; 1= Primary School; 2= Secondary School; 3= Tertiary School; 4= University	*'And the programme that brings universities and private sector together. I think you may find the programme also very interesting, as far as the information is interesting. It is called the UniBrain programme.' (Apollo Segawa, Curad)*
School Years	1= 0-2 years; 2= 3-4 years; 3= 5-6 years; 4= 7 years; 5= more than 7 years	-
Education Received	1= Strongly Disagree; 2= Disagree; 3= Neither agree nor disagree; 4= Agree; 5= Strongly Agree	*'Normally, we have the farmers training and education, this is number one to build capacity. It helps the farmers to really know the requirements of the certifications that they are going to participate in.' (Deus Nuwagaba)*
Training Received	1= Strongly Disagree; 2= Disagree; 3= Neither agree nor disagree; 4= Agree; 5= Strongly Agree	*'Yes, so those are number of challenges in the agriculture. Processing quality, they need training, capacity, building capacity of every farmer to adopt. Like, we need quality. The market requires quality producing.' (Moses Makaka)*
Experience	1= 0-5 years; 2= 6-10 years; 3= 11-15 years; 4= 16-20 years; 5= more than 20 years	*We are now trying to spread ahead the issue of ensuring that the curriculum reaches to enterprise development, rather than just theoretical and then look far a job (Apollo Segawa, Curad)*
Yield Per Hectare	(Total Coffee Beans Sales) / (Hectares of coffee trees)	*'When you get better returns of investments you will keep investing in productivity enhancing technologies. Ideally this should make you more competitive. Which has to lead to better food security. But the system that rewards meeting standards is crucial. But now it is still about quantity and quality. Not only quality.' (James Ssemwanga)*
Perceived Climate Change	1= Strongly Disagree; 2= Disagree; 3= Neither agree nor disagree; 4= Agree; 5= Strongly Agree.	*'The climate has changed. Sometimes it rains a lot and sometimes there is very little rain at times when you are expecting a lot of rain. Also, sometimes drought sets in when it is not expected.' (Nathan Mabonga)*

Cooperative membership	0 = No; 1 = Yes	*'As long as you are in the associations it is easy. Where it is very difficult is in the villages without associations, that's why we encourage the people to form associations' (Prof. Zake).*

Table 2 – Reliability Statistics for Perceived Climate Change

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,391	,329	5

Table 3 – Item-Total Statistics for Perceived Climate Change

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Climatechange_1	12,16	5,633	,405	,241	,128
Climatechange_2	11,24	9,680	-,103	,359	,532
Climatechange_3	10,63	9,402	,023	,033	,435
Climatechange_4	11,49	6,913	,253	,555	,291
Climatechange_5	12,13	5,788	,414	,325	,127

Table 4 – Multicollinearity tests, VIF and Tolerance

Multicollinearity	Tolerance	VIF
Region	0,253	3,949
Age	0,614	1,628
Gender	0,705	1,419
Access to Credit - Friends & Family	0,589	1,698
Access to Credit - Banks	0,22	4,542
Access to Credit - Microfinance	0,287	3,481
Access to Credit - Government	0,267	3,75
Perceived Climate Change	0,427	2,342
Access F&F* Climate Change	0,012	82,893
Access Banks* Climate Change	0,003	329,134
Access Micro* Climate Change	0,005	189,885
Access Government* Climate Change	0,002	409,139
Cooperatives	0,515	1,942
Access F&F* Cooperatives	0,056	17,912
Access Banks* Cooperatives	0,033	30,224
Access Micro* Cooperatives	0,062	16,161
Access Government* Cooperatives	0,05	19,872
School Level	0,477	2,095
School Years	0,373	2,682
Education Received	0,459	2,178

Training Received	0,534	1,874
School Level* Climate Change	0,011	93,846
School Years* Climate Change	0,009	114,403
Education* Climate Change	0,008	123,092
Training* Climate Change	0,009	106,185
School Level * Cooperatives	0,045	22,201
School Years * Cooperatives	0,041	24,526
Education * Cooperatives	0,063	15,914
Training * Cooperatives	0,073	13,757
Experience	0,512	1,953
Experience*Climate Change	0,016	61,071
Experience* Cooperatives	0,101	9,886

Table 5 – Descriptives and Correlations of Hypothesis 1

	Mean	S.D.	Agricultural Efficiency	Region	Age	Gender	Access to Credit - Friends & Family	Access to Credit - Banks	Access to Credit - Microfinance	Access to Credit - Government
Agricultural Efficiency	4052911,3	5459048,2	1							
Region	3,24	0,898	-0,421	1						
Age	4,25	1,031	0,109	-0,024	1					
Gender	0,84	0,372	0,219	-0,289	0,006	1				
Access to Credit - Friends & Family	2,264	1,9245	0,006	0,294	0,042	0,02	1			
Access to Credit - Banks	1,44	1,268	0,126	0,093	0,078	0,134	0,489	1		
Access to Credit - Microfinance	1,53	1,428	-0,116	0,18	0,2	0,183	0,383	0,781	1	
Access to Credit - Government	1,38	1,295	-0,079	0,137	0,153	0,092	0,497	0,818	0,719	1

Table 6 – Descriptives and Correlations of Hypothesis 2

	Mean	S.D.	Agricultural Efficiency	Region	Age	Gender	School Level	School Years	Education Received	Training Received
Agricultural Efficiency	4052911,3	5459048,2	1							
Region	3,24	0,898	-0,421	1						
Age	4,25	1,031	0,109	-0,024	1					
Gender	0,84	0,372	0,219	-0,289	0,006	1				
School Level	1,64	0,994	0,122	-0,24	-0,14	-0,001	1			
School Years	4,63	2,652	0,27	-0,492	0,18	0,341	0,564	1		
Education Received	2,63	1,429	-0,166	0,306	0,058	-0,007	0,301	0,116	1	
Training Received	3,14	1,628	0,039	0,116	0,244	0,152	0,146	0,217	0,558	1

Table 7 – Descriptives and Correlations of Hypothesis 3

Table 8 – Linear Regression

	Model	**M 1**		**M 2**		**M 3**		**M 4**		**M 5**		**M 6**		**M 7**		**M 8**	
	Observations	104		104		104		104		104		104		104		104	
	R^2	0,198		0,212		0,218		0,206		0,2		0,198		0,204		0,206	
	Variable	***p***	***β***	***p***	***β***	***p***	***β***	***p***	***β***	***p***	***β***	***p***	***β***	***p***	***β***	***p***	***β***
1	Region	0*	-0,388	0*	-0,43	0*	-0,41	0*	-0,363	0*	-0,379	0,002*	-0,374	0*	-0,422	0*	-0,411
1	Age	0,272	0,099	0,302	0,093	0,331	0,087	0,197	0,119	0,241	0,107	0,268	0,101	0,306	0,093	0,311	0,092
1	Gender	0,26	0,16	0,332	0,092	0,396	0,08	0,178	0,131	0,233	0,114	0,257	0,107	0,315	0,095	0,338	0,091
2	Access to Credit - Friends & Family			0,181	0,127												
3	Access to Credit - Banks					0,109	0,147										
4	Access to Credit - Microfinance							0,31	-0,098								
5	Access to Credit - Government									0,561	-0,054						
6	Perceived Climate Change											0,838	-0,023				
7	Access F&F* Climate Change													0,389	0,084		
8	Access Banks* Climate Change															0,311	0,094
9	Access Micro* Climate Change																
10	Access Government* Climate Change																
11	Cooperatives																
12	Access F&F* Cooperatives																
13	Access Banks* Cooperatives																
14	Access Micro* Cooperatives																
15	Access Government* Cooperatives																
16	School Level																
17	School Years																
18	Education Received																
19	Training Received																
20	School Level* Climate Change																
21	School Years* Climate Change																
22	Education* Climate Change																
23	Training* Climate Change																
24	School Level * Cooperatives																
25	School Years * Cooperatives																
26	Education * Cooperatives																
27	Training * Cooperatives																
28	Experience																
29	Experience*Climate Change																
30	Experience* Cooperatives																

* $P < 0,05$.

	Model	**M 9**		**M 10**		**M 11**		**M 12**		**M 13**		**M 14**		**M 15**		**M 16**	
	Observations	104		104		104		104		104		104		104		104	
	R^2	0,206		0,2		0,198		0,168		0,2		0,198		0,198		0,2	
	Variable	***p***	***β***	***p***	***β***	***p***	***β***	***p***	***β***	***p***	***β***	***p***	***β***	***p***	***β***	***p***	***β***
1	Region	0*	-0,357	0*	-0,375	0,002*	-0,398	0*	-0,418	0*	-0,39	0*	-0,386	0*	-0,389	0*	-0,376
1	Age	0,2	0,118	0,245	0,106	0,273	0,099	0,26	0,102	0,274	0,099	0,276	0,099	0,275	0,099	0,248	0,106
1	Gender	0,183	0,129	0,237	0,113	0,266	0,105	0,264	0,106	0,264	0,106	0,262	0,106	0,264	0,106	0,247	0,11
2	Access to Credit - Friends & Family																
3	Access to Credit - Banks																
4	Access to Credit - Microfinance																
5	Access to Credit - Government																
6	Perceived Climate Change																
7	Access F&F* Climate Change																
8	Access Banks* Climate Change																
9	Access Micro* Climate Change	0,323	-0,097														
10	Access Government* Climate Change			0,604	-0,049												
11	Cooperatives					0,908	-0,014										
12	Access F&F* Cooperatives							0,595	-0,056								
13	Access Banks* Cooperatives									0,965	-0,004						
14	Access Micro* Cooperatives											0,968	0,004				
15	Access Government* Cooperatives													0,995	-0,001		
16	School Level															0,621	0,047
17	School Years																
18	Education Received																
19	Training Received																
20	School Level* Climate Change																
21	School Years* Climate Change																
22	Education* Climate Change																
23	Training* Climate Change																
24	School Level * Cooperatives																
25	School Years * Cooperatives																
26	Education * Cooperatives																
27	Training * Cooperatives																
28	Experience																
29	Experience*Climate Change																
30	Experience* Cooperatives																

* $P < 0,05$.

	Model	**M 17**		**M 18**		**M 19**		**M 20**		**M 21**		**M 22**		**M 23**		**M 24**	
	Observations	104		104		104		104		104		104		104		104	
	R^2	0,199		0,201		0,2		0,198		0,198		0,202		0,198		0,201	
	Variable	***p***	***β***	***p***	***β***	***p***	***β***	***p***	***β***	***p***	***β***	***p***	***β***	***p***	***β***	***p***	***β***
1	Region	0,001*	-0,373	0*	-0,369	0*	-0,397	0*	-0,388	0*	-0,388	0,001*	-0,356	0*	-0,396	0*	-0,431
1	Age	0,315	0,093	0,257	0,103	0,353	0,087	0,268	0,101	0,296	0,096	0,241	0,107	0,312	0,095	0,25	0,104
1	Gender	0,314	0,098	0,241	0,111	0,319	0,096	0,261	0,106	0,298	0,102	0,231	0,114	0,286	0,103	0,285	0,101
2	Access to Credit - Friends & Family																
3	Access to Credit - Banks																
4	Access to Credit - Microfinance																
5	Access to Credit - Government																
6	Perceived Climate Change																
7	Access F&F* Climate Change																
8	Access Banks* Climate Change																
9	Access Micro* Climate Change																
10	Access Government* Climate Change																
11	Cooperatives																
12	Access F&F* Cooperatives																
13	Access Banks* Cooperatives																
14	Access Micro* Cooperatives																
15	Access Government* Cooperatives																
16	School Level																
17	School Years	0,738	0,036														
18	Education Received			0,542	-0,058												
19	Training Received					0,605	0,05										
20	School Level* Climate Change							0,833	0,019								
21	School Years* Climate Change									0,857	0,017						
22	Education* Climate Change											0,485	-0,071				
23	Training* Climate Change													0,858	0,018		
24	School Level * Cooperatives															0,492	-0,075
25	School Years * Cooperatives																
26	Education * Cooperatives																
27	Training * Cooperatives																
28	Experience																
29	Experience*Climate Change																
30	Experience* Cooperatives																

* $P < 0,05$.

	Model	M 25		M 26		M 27		M 28		M 29		M 30		M31		M32	
	Observations	104		104		104		104		104		104		104		104	
	R^2	0,199		0,198		0,198		0,2		0,198		0,2		0,395		0,746	
	Variable	*p*	*β*	*p*	*β*	*p*	*β*	*p*	*β*	*p*	*β*	*p*	*β*	*p*	*β*	*p*	*β*
1	Region	0,001*	-0,424	0*	-0,38	0,001*	-0,381	0*	-0,412	0,001*	-0,395	0,003*	-0,354	0,11	-0,264	0,062	-0,28
1	Age	0,254	0,104	0,28	0,098	0,277	0,099	0,481	0,073	0,364	0,094	0,32	0,091	0,069	0,194	0,242	0,10
1	Gender	0,264	0,106	0,26	0,107	0,261	0,106	0,345	0,093	0,295	0,103	0,259	0,107	0,148	0,143	0,234	0,09
2	Access to Credit - Friends & Family													0,317	0,108	0,228	0,59
3	Access to Credit - Banks													0*	0,802	0,000*	7,76
4	Access to Credit - Microfinance													0,004*	-0,452	0,000*	-2,99
5	Access to Credit - Government													0,006*	-0,445	0,000*	-4,68
6	Perceived Climate Change													0,941	-0,009	0,353	0,34
7	Access F&F* Climate Change															0,312	-0,55
8	Access Banks* Climate Change															0,000*	-7,70
9	Access Micro* Climate Change															0,001*	2,75
10	Access Government* Climate Change															0,000*	4,97
11	Cooperatives													0,596	0,061	0,270	0,36
12	Access F&F* Cooperatives															0,007*	-0,70
13	Access Banks* Cooperatives															0,356	0,30
14	Access Micro* Cooperatives															0,096	0,40
15	Access Government* Cooperatives															0,149	-0,38
16	School Level													0,591	0,064	0,598	0,27
17	School Years													0,823	-0,03	0,911	-0,06
18	Education Received													0,317	-0,122	0,609	-0,26
19	Training Received													0,557	0,067	0,722	-0,17
20	School Level* Climate Change															0,705	-0,2
21	School Years* Climate Change															0,955	0,03
22	Education* Climate Change															0,793	0,17
23	Training* Climate Change															0,789	0,16
24	School Level * Cooperatives															0,951	0,01
25	School Years * Cooperatives	0,643	-0,055													0,161	-0,41
26	Education * Cooperatives			0,851	0,019											0,453	0,1
27	Training * Cooperatives					0,895	0,014									0,910	0,02
28	Experience							0,605	0,058					0,961	0,006	0,393	0,35
29	Experience*Climate Change									0,925	0,012					0,390	-0,40
30	Experience* Cooperatives											0,615	0,057			0,085	0,32

* $P < 0,05$.

Table 9 – Model Summary to test Hypothesis 4

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	,445[a]	,198	,174	4962825,1939	,198	8,209	3	100	,000
2	,864[b]	,746	,632	3313306,7371	,548	5,288	29	71	,000

a. Predictors: (Constant), Gender, Age, Region

b. Predictors: (Constant), Gender, Age, Region, SchoolLevel_CC, Access_5, EducationReceived_Cooperatives, Training_received, Access_to_credit_FF, Experience, School_years, Education_received, ClimateChange_mean, Experience_Cooperatives, Access_4, Access5_Cooperatives, Access_3, SchoolLevel_Cooperatives, Access4_Cooperatives, TrainingReceived_Cooperatives, SchoolYears_Cooperatives, AccessFF_Cooperatives, Access3_Cooperatives, Cooperative, School_level, Experience_CC, AccessFF_CC, TrainingReceived_CC, Access4_CC, SchoolYears_CC, EducationReceived_CC, Access3_CC, Access5_CC

c. Dependent Variable: YieldPerHectare

Table 10 – Interviewee overview

Interviewee	Function
Apollo Segawa	Board member of CURAD
Arthur Wasukira	Researcher at NARO
Deus Nuwagaba	Board member of NUCAFE
Fred Tabalamule	Employee at Ministry of Agriculture
Frederik Kawanga	Coffee farmer
James Ssemwanga	Managing director of the Ssemwanga Centre for Agriculture and Food
Michael Kijjambu	Coffee trader
Moses Makaka	Marketing Manager at Baida Marketing Centre
Mutwalibi Galugali	Coffee farmer
Nathan Mabonga	Board member of Bugisu Cooperative Union
Piet van Asten	Agricultural researcher at IITA Uganda
Prof. Zake	Board member of UCDA
Sarah Mubiru	Senior Agricultural Advisor of SNV
Seguya Yassin	Coffee trader

Table 11 –Agricultural Efficiency Quotes

	Quote
1	*They know that using fertilizers and manure increases the productivity. But like in Mbale here it is different. We are not like in Kampala where they have a lot of grass, which they can cut; that is lacking Mbale because most of the parts are covered with crops. Mulching therefore becomes a problem. But they know if they have the mulching material that would increase productivity.*
2	*We know that the most effective way is to do a mix of various chemical controls. But we also know that the farmer may not be able to afford this..*
3	*We are looking at improving the yields of coffee and that will result in an increase of income. Coffee ha been a neglected crop with reduced management. Our main intervention there is on the management the coffee.*
4	*Uganda has so much land for so many centuries, but the population is growing but land stays the same so we need to enhance productivity and efficiency of farmers to coop with this growth. So now what we are trying to promote is to ensure that we bring practices that the farmers with small pieces of land to produce just like someone with a bigger piece of land.*
5	*I had a farmer who has been growing coffee, the last ten years and from this he picked a maximum of seventy bucks with two seasons of our interventions, we just put trenches and may some nutrients, the farmer got one-hundred and seventy bucks of coffee, just because of water a very simple solution.*
6	*The trainings always help us a lot. When they train you, you get a good yield of coffee because they teach you how to produce good quality. Actually, even during the harvest they teach you how to grade the good quality bean and also those that are not good. So they give us the necessary skills and knowledge and in the end they buy the product.*
7	*I think it has. The good thing is that they have linked with the farmers and the farmers are therefore getting a better price than they used to. The higher price will also inevitably increase the productivity. I think one of the ways to increase productivity is to increase the price.*
8	*When the yield is good I harvest 50 bags of 100 kilograms of coffee in one season. The yield is determined by the following factors: the rain, the weeding and the pruning. This year the yield was low because the weeding and the rain weren't good last year. I lost half of the yield because my land is affected by too much drought. The growth is stagnated the last years.*
9	*So essentially, the soil has become worse, which also has a big effect on the productivity. What we the tell the farmers, if you are planting the coffee, the most important is the rooting system.*
10	*The coffee is not going to be of good quality, there will be a lot of black beans and withered beans and floods, and those three are going to come. And also there are going to be a lot of insect damaged bear inside, because of the weather. So that first of all affects the price; it affects the market because most the people don't need such coffee.*
11	*When we look at the amount of hours a farmer has to work to get a certain output, many farmers are making loss. The coffee farming industry is too labor-intensive for the yield it provides.*
12	*If you want to intensify, you will get higher efficiency rates. But only if you follow the right steps and in t right sequence. Many farmers start with the usage of fertilizers when their pruning isn't good enough ye So first you need a good base before you can make further steps in intensifying your production.*
13	*When you look at the resources, the more you go to the further developed farmers you will see that the need different resources, for example money, knowledge and labor.*

Table 12 –Access to Credit Quotes

	Quote
14	*One is the enterprise development, using the incubation model, basically supporting ideas of business. This is a mix of business training, and facilities and providing a startup fund.*
15	*I: I can imagine that it is quite an investment for farmers. Is it easy to access credit for these investments? P: No it is not easy. Many banks do not lend money to farmers. I: What is the main reaso that the banks do not loan money to farmers? P: Because funding it is risky. They say coffee productio can be risky due to drought so the banks fear they will not get their money back.*
16	*The farmers do not have to money to build a factory at the individual level. But at the level of NUCAFE as an organization, we negotiate with the factory owners and processors to have this processing facilit Now the farmers can use this facility at a negotiated price, they only have to pay the user fee when we bring them together. We are an intermediate, we facilitate this process of negotiating and see to it that the farmers can have a place where they can meet the processing requirements of the certification. So when they are in that kind of arrangement, they pay fees. Every time when they bring a kilogram of coffee it is milled, and after milling, it is taking.*
17	*We work with the bank to the extent that they can provide money in advance to the farmers, as a loan. This is pre-financing. There are some buyers, like the ones we are selling coffee to, so when you sign a contract with them then they give an advance of about 50-60%, this goes to the farmers to grow the coffee, and then they wait for the final pay for when the coffee is ready to sell. Now that is where we facilitate these associations and cooperatives to have bankable business plans, because the memorandum of understanding with the local bank is about to be able to advance money to these smallholder farms which have a good bankable business plan and a good cash flow.*
18	*Yes, we facilitate the building capacity to have a businessperson to write it. We don't write a 100%. The also have a financial counselor. These people help the farmers to build a business plan and have a go cash flow. And when these associations get money from the bank, the work of the financial counselor, who we paid, is done. He provides financial coaching.*
19	*That is not easy, first of all the interest rates are very high. I think that at the moment they are around 24% and they need a mortgage, like their houses or trucks. And when you have nothing to put in, you can't get anything. So many people created their own understanding, like communities in villages, they*

	collect money and they lend it to one person. When that person pays back, they maybe lend it to someone else. This can be done with or without interest. Or at the end of a season they all collect a certain amount and give it to one person	
20	*Also the unions that are localized in communities are helpful, because they are easier in lending. They lend out very small amounts of money. For a big investment you still need a bank. Unfortunately people use their savings and run away with their saving and leave the others with nothing.*	Sarah Mubiru
21	*Did you ever need an investment from someone else such as friends, family, a bank or government institutions? P: If you have a big farm then automatically you can go for a loan. They will give you a loan to buy manure. I: From banks? P: From banks mostly yes.*	Frederik Kawanga
22	*If you want to get a loan you go to the bank which will assign you a loan officer. The loan officer then will come with you and surveys the land and look at the coffee and take photos of it. If you say want manure for production of coffee to get a good yield of coffee they then give you the money. What they expect to get money from is the coffee. I: Do many people get refused for a loan? P: Yes but most of the people do not go for loan because of that. If you have a small piece of land you cannot go to the bank for a loan.*	Frederik Kawanga
23	*There are ways of accessing credits but like anywhere in the world, today access to credit is very difficult. Very stringent interest rates. I: Which one is the most popular? P: Saccos, we call them Saccos (Savings and Credit Co-operative organizations in Uganda). They are usually small farmers' groups where they pull their resources together and share those resources. But commercial, like going to banks, is less common. So small associations, which help with micro financing, are most popular.*	Michael Kijjambu
24	*Now, the problem here, most of the coffee farmers are self-sponsored, they are not government-sponsored. So when they are affected by drought, you have to face it yourself. So, most of the farmers can not afford to irrigate*	Seguya Yassin
25	*For the organic traders, they get advise for a project here in Uganda. So the company has money, what they do is, the advance those peoples. When they inspect your field, and see that you have 500 trees, they estimate that you can yield coffee of around 1 million [Ugandan shilling]. So if you need 500 [thousand], they give you that money. The same applies to local banks, they can come and inspect your garden, after inspecting your garden they can see and borrow you that money.*	Seguya Yassin
26	*Most of the farmers access their credit locally, via his or her local village and not via the formal credit authorities. I think that even less than 20% of the farmers access credit through the formal authorities. It is all via informal and semi-formal structures. And many farmers make use of loans related tot heir coffee. They use their coffee beans as a security and sell their coffee for a very low price. The loans are a kind of usurious interest.*	Piet van Asten
27	*'Most of the times the intake sessions is not that strict which leads to a high failure percentage of the investment'*	Piet van Asten

Table 13 – Education Quotes

	Quote	Interviewee
28	*The farmers that we work with and the farmer organizations we work with have trainings with them. Or when we support particular farmers in different areas, we try to have those farmers use the best technologies that are available, then the actors against of change for a particular. So it is basically our support activities to the farmers and farmers' organizations plus the workshops and conferences and the trainings that we have with the groups.*	Apollo Segawa
29	*Normally, we have the farmers training and education, this is number one to build capacity. It helps the farmers to really know the requirements of the certifications that they are going to participate in.*	Deus Nuwagaba
30	*So we do empower them to train each other, and to ensure that they are able to themselves as leaders of these cooperatives and associations to move down and train their own, as master trainers. They implement what we call an internal control system and then within an internal control system, there is a total quality management system. So we have what we call a TQM system.*	Deus Nuwagaba
31	*Yes, so those are number of challenges in the agriculture. Processing quality, they need training, capacity, and building capacity of every farmer to adopt. Like, we need quality. The market requires quality producing.*	Moses Makaka
32	*We also do business development trainings, mainly to the farmers. Access to information is one of the biggest challenges. If you don't know it is hard to adapt.*	Arthur Wasukira
33	*We do this mostly by communities. There are a number of strategies. First we train trainers of trainers. This is entails that we select an individual an we train extension workers, but there is a time we go to the groups, and they go back to the community and they train other members of that community in practices and technologies and also provide knowledge regarding climate control and changes.*	Fred Tabalamule
34	*We are encouraging farmers continuously since it is enhancing their productivity, I will share with you I am doing a documentary with my farmers, which were surprised by farmer's conventions. I had a farmer who has been growing coffee, the last ten years and from this he picked a maximum of seventy bucks with two seasons of our interventions, we just put trenches and may some nutrients, the farmer got one-hundred and seventy bucks of coffee, just because of water a very simple solution.*	Fred Tabalamule
35	*The trainings always help us a lot. When they train you, you get a good yield of coffee because they teach you how to produce good quality. Actually, even during the harvest they teach you how to grade the good quality bean and also those that are not good. So they give us the necessary skills and knowledge and in the end they buy the product.*	Frederik Kawanga
36	*Through talking, knowledge sharing it is the best way to engage people in using the best practices that are available for them, at a local level. Sometimes as you discuss with the farmers - when you listen to them - you may never know that some people have defaults. Because they might say: 'we did this and we got that.' But then when you take it, and analyze it you may find this has various types.*	Prof. Zake
37	*Many authorities focus on training, but many times is training not the depending factor for adaptation to technologies. We work on the development of technologies but many farmers do not implement these technologies. What are the drivers and incentives of farmers to implement these technologies?*	Piet van Asten

38	'*Sometimes after a training we visit the coffee farmer and then we figure out that he has sold his coffee in an earlier stage for a lower price. At that moment he chose to have a guaranteed income above a better price at a later stage'*	Piet van Asten
39	*We are trained. For example in what we have to do when we see an affected plant. In that case, we have to cut the affected trench and abandon it from there.*	Mutwalibi Galugali

Table 14 – Experience Quotes

	Quote	Interviewee
40	*They have a very theoretical curriculum at the study and they don't have a business end-off. I mean you still study science, no one gives you any information how you make money out of science. So studies are quite theoretical, or most of them are still like that. We are now trying to spread ahead the issue of ensuring that the curriculum reaches to enterprise development, rather than just theoretical and then look far a job. So we want to ensure that there are more entrepreneurs and job creators than job seekers,*	Apollo Segawa
41	*I think price is a big challenge. If you audit what the farmers put in and they get out, if you put it in numbers, the price is still too low. I think another challenge for the farmers is that they should change some of their ways, even within the same price structure. I think they got to change some of their ways they do their things.*	Michael Kijjambu
42	*There is a program of replanting, and the farmers are very resistant. They got trees, which are forty or fifty years old. I think it is time to uproot them and replant but the farmers do not want it. Some of their agricultural crop culture has to be changed. That is a big challenge, changing the culture. Most of the farmers are quite old. It is good now we are seeing more young farmers. We have started this young farmers' association. The young, more energetic better educated Ugandans so they can become farmers.*	Michael Kijjambu
43	*For example coffee and cacao are old men clubs. In this business work especially men because it is a cash crop. You need land tenure for cash crops. You need the land for 3 or 4 year before it produces a good product. We are now trying to rejuvenate the business. Making agriculture more attractive for young people.*	Piet van Asten

Table 15 – Perceived Climate Change Quotes

	Quote	Interviewee
44	*The coffee variety being grown now is very vulnerable to drought. So the experience in some areas is that you actually find chambers wiped out.*	Apollo Segawa
45	*The climate has changed. Sometimes it rains a lot and sometimes there is very little rain at times when you are expecting a lot of rain. Also, sometimes drought sets in when it is not expected.*	Nathan Mabonga
46	*Did you adopt any techniques to avoid over raining or over shining? P: There is no solution for that, it is natural. When it is raining it is raining, you cannot avoid it. Also when it over shines you will lose the weight of the product. The coffee becomes of poor quality.*	Frederik Kawanga
47	*P: I have been reading it in the papers but I do not know if we have also felt the effect already. But what I know is that the seasons have shifted a bit but personally I have no evidence to link it to coffee production.*	Michael Kijjambu
48	*When the yield is good I harvest 50 bags of 100 kilograms of coffee in one season. The yield is determined by the following factors: the rain, the weeding and the pruning. This year the yield was low because the weeding and the rain weren't good last year. I lost half of the yield because my land is affected by too much drought. The growth is stagnated the last years.*	Mutwalibi Galugali
49	*Obviously as we are talking about coffee one is: how are we going to mitigate against global warming? Especially for coffee this is a difficult threat, because if the temperature increases to 33 degrees, there is a likelihood that the coffee will come down tremendously. Especially along the high lines. So we are saying: 'how will we combat that?' Basically we want to yield as much organically as possible, so it increases moisture retention. The soil should be prepared as much organically as possible.*	Prof. Zake
50	*The most serious problem here in Uganda as far as coffee production is concerned, is the change in weather. Like this year, as we are talking, we are supposed to be in the rain season. The rain season was supposed to start in March, or late February, but up to now in the village there is no rain. So, in that, we have found that most of the coffee, the season for Robusta starts in April and ends around September. But now the coffee should almost be ripe, but because of the weather it has refused and it has turned to be withered. Most of the beans are now withered inside, they are not of good quality*	Seguya Yassin
51	*The coffee is not going to be of good quality, there will be a lot of black beans and withered beans and floods, and those three are going to come. And also there are going to be a lot of insect damaged beans inside, because of the weather. So that first of all affects the price; it affects the market because most of the people don't need such coffee.*	Seguya Yassin
52	*Now, the problem here, most of the coffee farmers are self-sponsored, they are not government-sponsored. So when they are affected by drought, you have to face it yourself. So, most of the farmers can not afford to irrigate*	Seguya Yassin
53	*But if the weather is not okay, the quantity can be reduced by the two seasons that remain.*	Seguya Yassin
54	*So drought is a serious problem, in fact to me, it is the main problem here, as far as coffee production is concerned. Farmers can't even try, because those farmers who can afford to irrigate, there are very few*	Seguya Yassin
55	*And then problem number two is when there is a drought: 'wilt' comes. Coffee wilt is where coffee trees are dried up, gradually. They die completely, but it is gradual.*	Seguya Yassin
56	*Another thing, when the rain is too much, drying coffee is a problem because in the villages they use the sun to dry. So when there is the rain season, it takes a long time to dry up from the red seed to FAQ. So it can take a farmer up to a month of drying to reach the desired state*	Seguya Yassin

Table 16 –Membership of Cooperatives Quotes

	Quote	Interviewee
57	*The farmers do not have to money to build a factory at the individual level. But at the level of NUCAFE, as an organization, we negotiate with the factory owners and processors to have this processing facility. Now the farmers can use this facility at a negotiated price, they only have to pay the user fee when we bring them together. We are an intermediate, we facilitate this process of negotiating and see to it that the farmers can have a place where they can meet the processing requirements of the certification. So when they are in that kind of arrangement, they pay fees. Every time when they bring a kilogram of coffee it is milled, and after milling, it is taking.*	Deus Nuwagaba
58	*We have also trained the farmers, which we then call business managers, at each of the associations or cooperatives. They take care of all the other farmers we cannot reach. Because these cooperatives and associations belong to them as farmers. So we do empower them to train each other, and to ensure that they are able to themselves as leaders of these cooperatives and associations to move down and train their own, as master trainers.*	Deus Nuwagaba
59	*I: but in general, farmers who are connected to an association are more aware of course regarding sustainability, because they receive training, they know how to use fertilizers. P: Exactly, training, fertilizers, whatever challenge they can deal, as more you want to access you come these day.*	Moses Makaka
60	*Also the unions that are localized in communities are helpful, because they are easier in lending. They lend out very small amounts of money. For a big investment you still need a bank. Unfortunately people use their savings and run away with their saving and leave the others with nothing.*	Sarah Mubiru
61	*So through combining the efforts of different stakeholders they can add value and also the government is promoting the concept of value addition, and they also put in consideration that to ensure that we help farmers that they select the best crops where they can get advice, where they can market it, use the right practices to produce, and at the same time minimize the costs, so that they are able to get some good margins, which encourages them to continuously produce.*	Fred Tabalamule
62	*Before Kawacom I would sell at a very low price because of the poor quality at a price of 2500 to 3000. When Kawacom came we produced better quality and were able to sell at 9 or 10.000.*	Frederik Kawanga
63	*The association is helping us in several ways. First of all, they help us by showing how to manage the coffee plantation. Second, they help us by providing pruning devices. But we still have challenges in post-harvest management. We need for example better equipment to improve the drying of the beans. We also don't have big spray-systems that can reach the entire field. Another challenge is that the chemicals are expensive.*	Mutwalibi Galugali
64	*Well, first of all, when you make associations. It is very easy to communicate, because they assemble all the farmers for export. So within themselves, mutually you can say: use this and this technique.'*	Prof. Zake
65	*Through talking, knowledge sharing it is the best way to engage people in using the best practices that are available for them, at a local level. Sometimes as you discuss with the farmers - when you listen to them - you may never know that some people have defaults. Because they might say: 'we did this and we got that.' But then when you take it, and analyze it you may find this has various types.*	Prof. Zake
66	*When you are a coffee farmer, you are forced to join a group because of an economic incentive. This group gives a certain structure that enables people to communicate standards to the farmer. But it is not illegal to produce coffee outside that structure. And you can still produce you coffee and remain important without belonging to any structure or system. And I think that that is the problem.*	James Ssemwanga

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