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Going nuts: Macadamia farming as a livelihood strategy for Kibugu's farmers

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Abstract

In the last years, the price of macadamia has been on the rise, and it has become a prosperous crop for the farmers in Kibugu. 94% of the farmers in our questionnaires grow macadamia which is also regarded as the second most important cash crop in Kibugu. This report looks at the outcomes of farming macadamia and how it influences farmers' livelihoods. The fieldwork for this study explored the production and trading processes within the macadamia market as well as the interactions between the actors. We found out that the income from macadamia is used to secure food, pay school fees and on immediate needs. The macadamia market is characterized by price volatility and an unstable structure where everyone seeks to maximize their own interest. It has resulted in mistrust and theft. Furthermore, we found that most farmers lack knowledge on the best practices for taking care of their macadamia trees which impedes them from reaching the potential yields. Given that the link between the agricultural office and the macadamia farmers is weak, the extension services available are not being utilized for this sector. Overall, macadamia farming helps improve the livelihood of small-scale farmers by bringing additional income to the household. However, strengthening the existing assets and building a better market structure will help them develop better farming practices. In order to support a sustainable development of the macadamia industry in Kibugu, we advice the provision of trainings on better farming practices and self-organisation groups.

Keywords: macadamia, small-scale farmers, livelihood, self-organisation group, extension services.

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Picture 1: The entire research team (f.l.t.r.): Stephen, Karen, Bingzhi, Matthew, Miluska, Annika & Signe.
Source: Fieldwork photos

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Abbreviations

FGD: Focus Group Discussion

KSH: Kenyan Shillings

PRA: Participatory Rural Appraisal

SSI: Semi-structured interview

USD: US Dollars

1. Introduction

1.1 Background

Kenya's population has more than doubled from 23 millions in 1990 to 49 millions in 2017. In the same time frame, the gross national income per capita has expanded from 380 USD to 1460 USD (World Bank Report, 2018) signalling strong economic growth. Although the benefits of economic growth were expected to convert into development for sustainable livelihoods for the entire population, this did not happen (Ministry of Devolution and Planning, 2017). In 2017, the Ministry of Devolution and Planning reported that approximately 45.96% of the population live below the poverty line (2017), which is set at 1.25 USD per day per person. This means that about half of the population suffer from a "lack of access to basic necessities such as food, clothing and shelter" (Ministry of Devolution and Planning, 2017).

75% of the Kenyan population depend directly or indirectly on agriculture to support their livelihood (Murioga et al., 2016). Farmers constitute the larger part of the population and account for 61.1% of the labour force (CIA, 2019). Yet, the agricultural sector only accounts for 26% of Kenya's GDP (Murioga et al., 2016). One of the main horticultural exports of Kenya is the macadamia nut with 99% of this produce being exported. Globally, the Kenyan macadamia production accounts for 10% of the macadamia world production. (Mbora, Jamnadass, Lillesø, 2008; Mbora et al., 2008). Unlike other macadamia producing countries, the production of macadamia in Kenya relies on small-scale farmers (Africa Research Bulletin, 2019). Small-scale farmers grow between 6 to 100 macadamia trees which are intercropped with coffee or other food crops (Muthoka et al., 2008). In Embu, a hybridisation of the *Macadamia integrifolia* and the *Macadamia tetraphylla* called EMBU 1 is commonly farmed (Mbora et al., 2008). Within Kibugu, this hybrid of *M. tetraphylla* and *M. integrifolia* is commonly known as a grafted 'Mugumo' (Questionnaire fieldnotes; Macadamia nursery fieldnotes).

The price of macadamia is rising. A kilogram of shelled nuts went from 70 KSH in 2017 to 180 KSH in 2018 (Gebre & Nyambura-Mwaura, 2018). Because of the rising prices, more farmers are focusing on the production of macadamia nuts as a cash crop (Gitonga et al., 2009). The macadamia industry in Kenya involves more than 100.000 small scale farmers that use macadamia to diversify their production (Mburu et al., 2016). Due to high prices and low maintenance requirements, macadamia is perceived as being able to reduce poverty among the small-holder farmers in Embu (Embu County Report, 2016). In an attempt to expand the county's macadamia production and

quality, Embu County is supporting farmers with providing macadamia seedlings (Embu County Report, 2016).

Part of the responsibilities of the Ministry of Agriculture is to provide extension services (Embu County, 2009). Although a decentralization of agricultural extension services took place in the 1990s, extension services provided by the government continued to be perceived as the best for their quality. This is why the advice of government extension agents is continuously requested (Nambiro, Omiti, Mugunieri, 2006). Income, literacy levels and gender of the household head has an impact on the likelihood of farmers receiving these services (Nambiro, Omiti, Mugunieri, 2006) .

Despite support from the government, the production of macadamia nuts is far from reaching the potential yields of the crop (Sato & Waithaka, 1998). The infrastructure for nut processing is inadequate and there is a scarcity of scientific information on appropriate crop management techniques and knowledge on pest and disease control (Sato & Waithaka, 1998; Mburu et al., 2016;). Development programs designed to improve the macadamia industry in Kenya have failed to take a bottom-up approach during the participation and decision-making process (Gregoratti, 2011). As a result of the top-down approach, the Kenyan small-scale farmers have not been empowered nor benefitted from the projects.

Even under the context of climate change, agricultural lands continue to be suitable for macadamia plantation as macadamia helps retard forest degradation (Barrueto et al., 2018). Besides, smallholder farmers could achieve a 178% economic benefit when intercropping coffee with macadamia instead of growing only coffee (Perdoná & Soratto, 2016). The best yield is achieved from grafted seedlings (Cha-um et al., 2011). T As the flower is self-incompatible, it is advantageous for the farmers to plant flowers to attract pollinators (Howlett et al., 2015; Yang et al., 2018). Especially when the macadamia tree blooms from September until January. The further development of the fruit lasts around 8 months and to secure an optimal harvest it is encouraged to wait for the mature nuts to fall of the tree (Nagao et al., 1992) . Pruning should be done after harvest, when the tree is not bearing flowers or nuts to make sure it has the appropriate height and width. (Olesen et al., 2007; Wilkie et al., 2010).

The research for this project was conducted in Kibugu location which is found in Embu County, Kenya (Map 1). Kibugu is located 1,600 m above sea level. The rainfall quantity is around 1500 mm per year and with temperatures between 15°C to 30°C. Kibugu consists of 740 households, most of which own at least one plot of agricultural land to support their livelihood.

Map 1: Map of Embu county's location in Kenya. Source: Limu

Within Embu County, 70.1% of the population is employed in agriculture and 87.9% are engaged in agricultural activities (Embu County Report, 2016). The main source of income for small-scale farmers in Embu county are agricultural products, especially coffee, tea and macadamia (Mburu et al., 2016). In 2016, the Embu County Department of Agriculture identified several challenges within the macadamia industry. They pointed out that macadamia factories and companies source the nuts from farmers and brokers without following a regular scheme. This means that unlike the coffee industry, there is no legal and regulatory framework for the macadamia production (Embu County Report, 2016). Knowledge on the local organization structure is not clear and the small-scale farmers seem to lack consistency as to whom they sell their nuts to. This lack of uniformity leads to farmers getting paid low prices for their nuts and sometimes getting cheated in the trade transaction (Sato & Waithaka, 1998).

1.2 Literature review

The field of livelihood in the macadamia sector is one that not many studies address. Most published and peer-reviewed literature on macadamia focuses on the nuts and not on the producers: Perdoná & Soratto (2015) focus on increasing the quality and yield of macadamia nuts through irrigation and intercropping, without touching upon farmers' livelihoods or income. Murioga et al. (2016) lament the lack of organisational structure, quality control and certifications within the macadamia sector. Mburu et al. (2016) argue for agrobiodiversity conservation and regard diversity in small-scale farming as the key indicator for securing food security and income generation without addressing macadamia's role

in this. Walton & Wallace (2014) concentrate on the effects of machinery de-husking methods. Gregoratti (2011) centers around the failure of two macadamia processing factories, failing to mention whether farmers profit from their involvement with the factories. Gregoratti's presumption is that if "all the expected beneficiaries were given more voice in the phases of project selection and implementation" (2011) the failure of the companies could have been prevented. Choosing bottom-up engagement mechanisms to engage farmers has the potential to contribute to employment and income generation. Muthoka et al. (2008) lay open the possibilities of policy development within the macadamia sector, but focus on productivity. Whilst they detail on macadamia nut price and quality, they conclude by saying that "the development and growth of a vibrant nuts sub-sector [...] will improve farmers' income, increase foreign exchange earnings, create employment, reduce poverty and enhance their living standards through increased production, processing and marketing of nuts" (Muthoka et al., 2008), but give no indication of how this could be achieved. This is exemplary of many studies where the potential of macadamia is advocated, but no details on how these benefits can be achieved are given. We therefore find farming macadamia as a livelihood strategy to be a research gap, and hope to contribute to the necessary discussion with our findings.

1.3 Knowledge gap

Previous studies on the topic of macadamia nuts in Kenya have focused on the natural strategies to enhance the productivity of the trees. Little attention has been given to the impact that macadamia farming has on the livelihoods of small-scale farmers and their perception of the challenges they face within the production and marketing processes. For our research we will look at farming as a social notion that not only includes the physical management techniques, but also good farm management practices which are affected by the socio-cultural factors in which the farmer operates (Vanclay., 1998). In that sense, the focus of our study will be on how current buying and selling process between the macadamia actors take place. The small-scale farmers' reality and practices will be emphasized to understand the institutions within the macadamia market and their impact on the farmers livelihood.

1.4 Objective and research questions

Objective: How is macadamia farming improving the livelihood of small-scale farmers in Kibugu?

Research Questions:

1. How do institutions and organizations within the macadamia market shape the actions of the macadamia farmers in Kibugu?
2. How do farmers' assets determine their macadamia management practices?
3. What are the challenges present in the macadamia market?

1.5 Theory and conceptual framework

We will use components of the Sustainable Livelihood Framework (SLF) to understand how the different actors navigate the macadamia market. The SLF was developed as a tool to understand livelihoods and how different factors and processes interact with each other (DFID, 1999). The five main components of the SLF are the vulnerability context, the livelihood assets, the institutions and organizations, livelihood strategies, and sustainable livelihood outcomes (Scoones, 1998). The vulnerability context relates to how the external environment affects the availability of assets and livelihood strategies of people. The livelihood assets can be considered the strengths that people possess. These can be the human, physical, natural, social and financial capitals available. Human capital are factors such as health, knowledge and skills that allow someone to achieve their livelihood objective. Physical capital includes the basic infrastructure to support livelihood. Natural capital means natural resources such as land, water and biodiversity which are needed for resource-based activities. Social capital are the social resources that people draw upon to pursue their livelihood. Financial capital are the financial resources that people use to achieve their livelihood. (DFID, 1999). It is the combination of these assets that results in a positive livelihood outcome (DFID, 1999). Scoones (2015) defines institutions as the "rules of the game", and organizations as the "enacters". Each set of organizations and institutions are embedded in a particular context, some rooted in law and others more informal, where they have their own advantages and disadvantages. People then choose to follow the set that is most likely to provide a desirable outcome. The livelihood strategies component involves the range of activities and choices that people undertake in order to achieve their livelihood goal. Finally, livelihood outcomes refer to the outputs or achievements after employing certain livelihood strategies. Some examples of these outputs are: more income, reduced vulnerability, improved food security, among others (DFID, 1999).

The component of institutions and organizations is often overlooked in the SLF (DFID, 1999), which is why we would like to emphasis it during our results analysis. Looking at this component will allow us to understand the different rules and norms relevant to the farmers, brokers and factories. It will also illustrate how these main actors navigate and choose between the different institutions and organizations present on the macadamia market. Institutions and organizations are fluid, and the rules within are constantly being negotiated (Scoones, 2015). Thus, the macadamia market can be seen as an arena which provides multiple options, and actors have to make decision as to which set of institutions and organizations to follow.

2. Methodology

2.1 Rationale for choosing methods

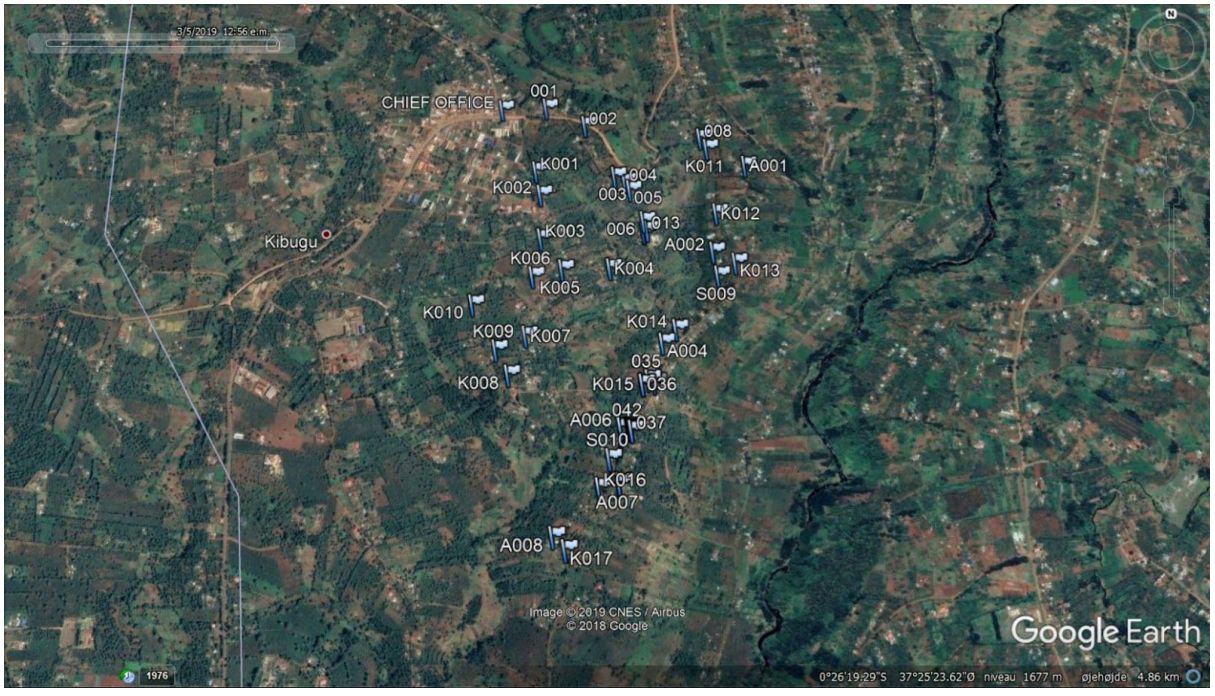
Given that our focus is to understand how the macadamia market and the social dynamics between the different actors in Kibugu work, we chose three qualitative methods; semi-structured interviews, participant observation and focus group discussion, and one quantitative; questionnaires, for our data collection. Questionnaires can be used to gain insight into the general tendencies of the sample population (Bernard, 2011). We used this method to capture the current farming practices among macadamia farmers, and obtain a general understanding on how the macadamia market operates. In the field, the questionnaires were also helpful to identify key informants for our Semi-Structured Interviews (SSI). SSIs are structured around an interview guide with established research themes (See appendix for interview guides) with allowance to expand on the topics that the informants themselves consider important (Bernard, 2011). We decided to carry out SSIs with the main actors in the macadamia market - farmers, brokers, companies - which allowed us to get a better understanding of the market's social dynamics. Furthermore we conducted an interview with the Agricultural Officer in Embu in order to gain the government's position and interests within the macadamia industry.

Focus Group Discussion (FGD) is used to discuss a topic with a particular group of people (Bernard, 2011). Our focus group was conducted to understand the perspectives of farmers in regards to their macadamia farming activity. Participant observation is utilised to observe the everyday practices of the informants and understand the context in which the research is situated (Bernard, 2011). For the FGD and SSIs we incorporated a few Participatory Rural Appraisal (PRA) tools. PRA are short exercises where the informants are encouraged to present their knowledge in an often visual matter (Bernard, 2011; Mikkelsen, 2009). Furthermore GPS-tracking was done during the questionnaires in order to create a visual map of the sampled households.

For our data collection we often divided the team into three groups so that each group had one student from the University of Nairobi. This decision was made in order to have one Swahili or Kiembu speaker in each group, so that we could conduct the questionnaires or interviews in the local language if the farmer was not comfortable speaking English.

2.2 Questionnaires

We collected 36 questionnaires in the sub-locations of Kibugu, Gicherori and Ngerwe, which are found within the Kibugu location. The questionnaires were collected over two days. To secure representivity, we used a random systematic sample (Bernard, 2011). This means that a random starting point was chosen and every fourth household was then approached for the questionnaire. We then collected questionnaires following transect lines identified by our two guides who also introduced us to the households before we conducted the questionnaires (see Appendix 2). Every household visited was tracked with waypoints on our GPS, which are illustrated in our sample map (Map 2).



Map 2: Showing the location of the chief's office and our sampled household for the questionnaire collection. Source: Google Earth + GPS Data

2.3 Semi-Structured Interviews

A total of ten semi-structured interviews including three farmers, six brokers, one representative from a macadamia factory and the agricultural officer of the region, were conducted over four days. The

farmers were selected according to their disposition to share information during the questionnaires, their willingness to be contacted afterwards, and any interesting answers provided that encouraged further investigation. We approached the brokers on the market when we were observing the transactions and dynamics. The SSI with the agricultural officer was arranged by our supervisors, and took place in the house of one of the host families. The nursery and factory that was visited belonged to Limbua Group Limited, formerly known as MacadamiaFans, which was introduced to us by one of our hosts who is a member of this company.

Picture 2: The research team conducting the SSI with the Agricultural Officer. Source: Fieldwork photos

2.4 Focus group discussions

We planned to conduct a FGD with ten macadamia farmers, five male and five female, selected from our questionnaires. Even though all ten of them confirmed their participation, the FGD was only carried out with four farmers (Appendix 7). We held the FGD at the chief's office due to its familiarity for the farmers, and the fact that it was approximately the same distance between all households. The FGD lasted two and a half hours and most of the discussion was in Kiembu. To engage the participants, two PRA exercises were carried out in the form of a seasonal calendar and a ranking matrix. They were used to determine the months of harvesting, price fluctuations, the threats involved in macadamia farming and the effects of intercropping macadamia with other crops.

Picture 3: The participants of our focus group discussion. Source: Fieldwork photos

2.5 Participant observation

Living with local families gave us a great opportunity to gain insight into the lives of macadamia farmers. By participating in everyday activities and meals, we got a greater understanding of what it is like to be a macadamia farmer in Kibugu. With the trust developed, and the information gathered through these informal interactions, we were able to understand the local context of our study. Being part of the everyday life in Kibugu enable us to observe farming practices and transactions taking place, which have been very valuable for our data collection.

3. Results and analysis

3.1 Characteristics of the Kibugu Farmer

The small-scale farmers that were involved in our research share the following characteristics: 38.9% are between 25 to 45 years of age, 38.9% between 46 to 65 years of age, and 22.2% between 66 to 85 years of age (Questionnaire data). This indicates that the majority of farmers in Kibugu are elders. The majority of farmers attended primary school but a large portion also attended secondary education (Figure 1).

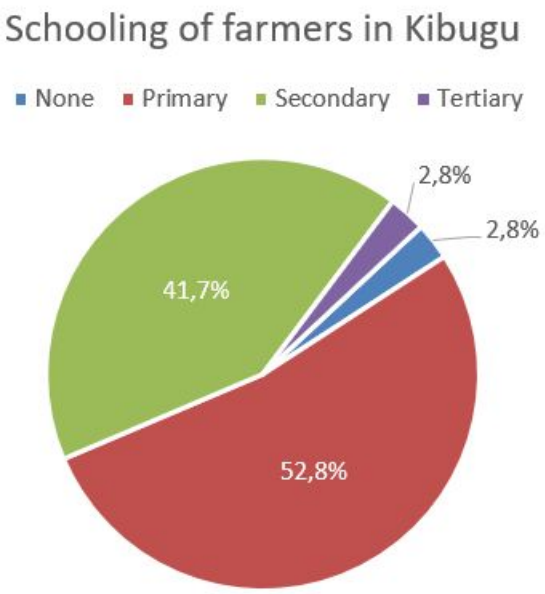


Figure 1: Share of farmers highest degree of education. Source: Questionnaire data

Additionally, 94.4% of the questionnaire respondents state that farming is their main source of income. There is a wide range for how many years ago the respondents started farming, and Figure 2 illustrates this distribution. The highest number of farmers fall within the category of starting farming 20 years ago. (Questionnaire data).

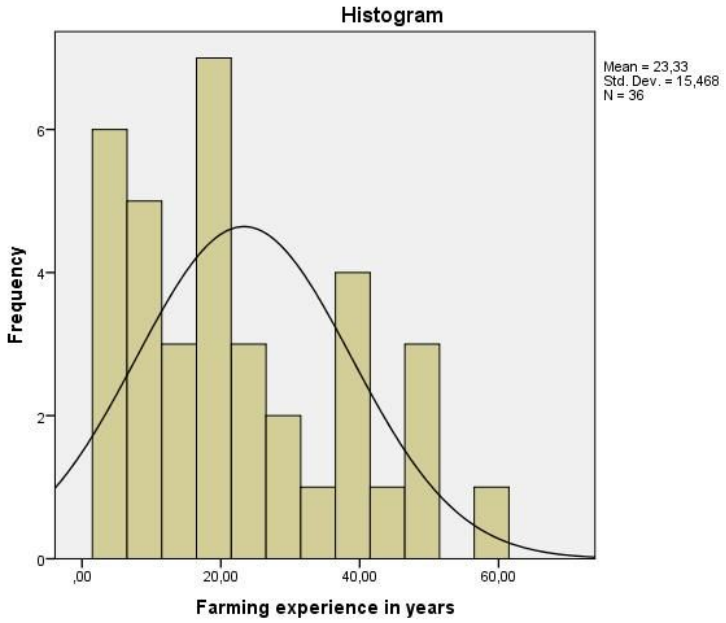


Figure 2: Frequency distribution of how many years ago the questionnaire respondents started farming. Source: Questionnaire Data

In regards to the number of trees, more than half of the farmers (58%) have between zero to ten trees (Figure 3).

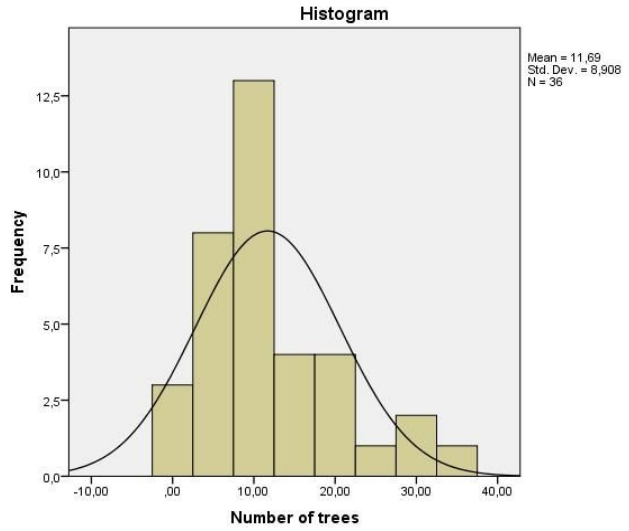


Figure 3: Amount of macadamia trees the farmers in Kibugu own. Source: Questionnaire Data

86.1% of the farmers have one plot of land, also called shamba, where the number of trees varies greatly from one farmer to another. However, there is a positive correlation between the number of shambas and the number of trees (Figure 4). This means that the more shambas the farmer has, the more macadamia trees the farmer owns. 57.1% of famers' shamba size is under one acre. There does not seem to be any correlation between the number of trees and the level of education or gender of the farm owner.

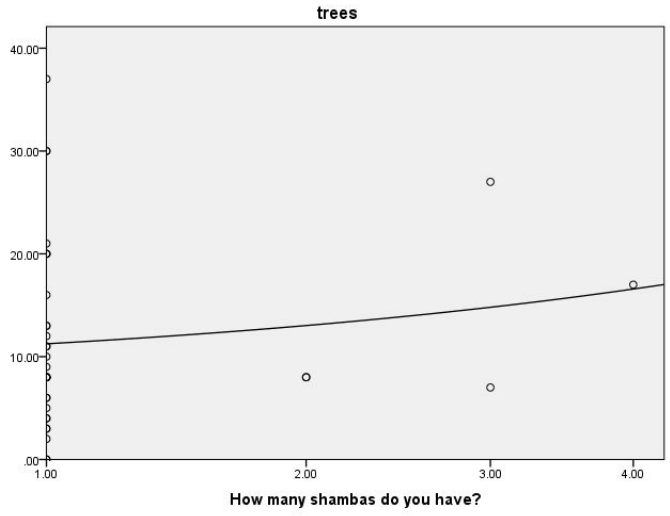


Figure 4: Positive correlation between the number of trees and the number of shambas. Source: Questionnaire Data

3.2 Vulnerability context

We have identified three main aspects that make the macadamia farmers vulnerable within the macadamia market. The three aspects are: Pests, climate and price fluctuations.

3.2.1 Pests

Among our questionnaires, 81% of farmers consider pests a threat for macadamia farming. Within this group, 72% regard it as one of the most pressing issues (Questionnaire data). As Kibugu is bordering a forest area, many of the farms close to the forest experience issues with bush babies and vervet monkeys stealing nuts (FGD). Farmers' attempts to keep them away by building fences or throwing rocks has proven futile. Given that they are under wildlife protection in Kenya, nothing can be done to prevent them from expanding their territory. (Questionnaire fieldnotes; SSI 1). Another pest that attacks the macadamia trees are mosquitos. By attacking the flowers they cause the nuts to fall down prematurely. They also nest in the nuts eating them from the inside. This creates a hole as seen in Picture 4 (Questionnaire fieldnotes; FGD). The word "mosquitos", as used by the farmers, could be a term that emcompasses a variety of insects attacking the trees.

Picture 4: A hole in a macadamia nut attacked by 'mosquitos'. Source: Fieldwork photos

3.2.2 Climate

The yield of the harvest is also vulnerable to climate. We were told repeatedly that last year's decrease in yield was due to the cold and rain (Questionnaire fieldnotes). The changes in climate promote

heavy rain, winds, and can influence the intensity of pests (Haq, 2011). 55% of farmers consider climate as one of the three most pressing challenges influencing macadamia farming (Questionnaire data). However, they are also aware that this threat is beyond their control. One farmer explained how the intensity of rain cannot be predicted therefore some years it can be considered a very serious issue and other years a not so serious one (SSI 4).

3.2.3 Pricing

The price of macadamia in Kibugu has two main characteristics; it fluctuates a lot and it is high in relation to other cash crops.

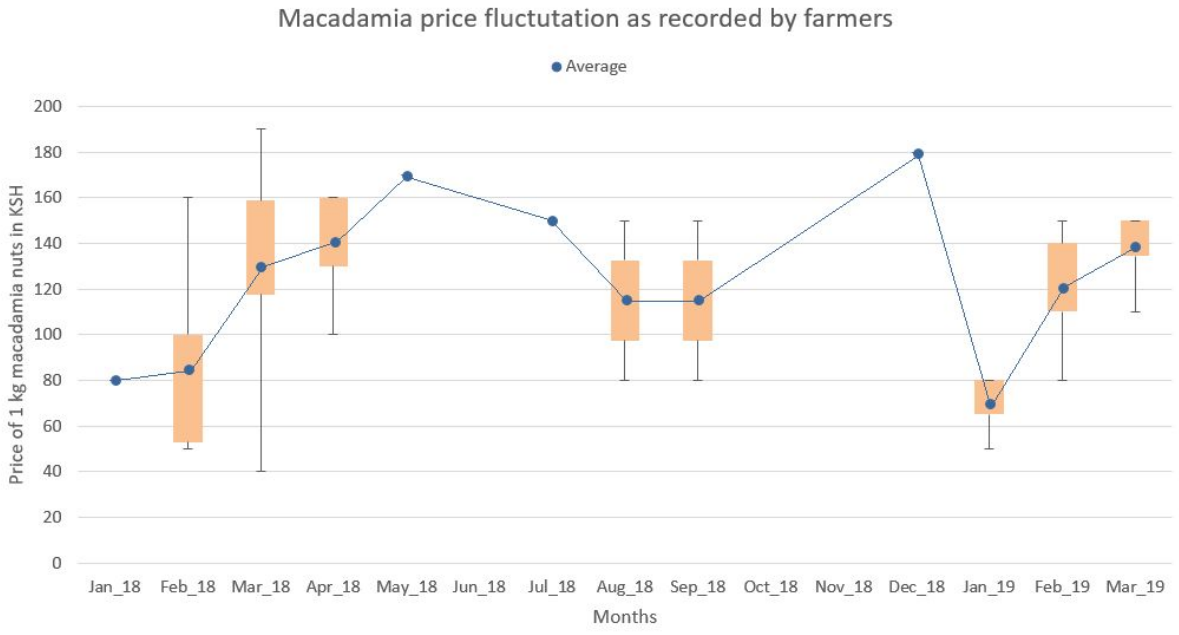


Figure 5: Macadamia price fluctuation throughout the last fifteen months in Kibugu as recorded by farmers. Source: Questionnaire Data

Figure 5 illustrates farmers' responses in regards to the price at which they sold their last macadamia harvest. The blue mark is the average price at which farmers sold their nuts for that month. The variation in price responses for a particular month (minimum and maximum) are shown by the whiskers whilst the yellow box in the middle contains 50% of the responses for that month (Questionnaire data). As illustrated by the boxplot, the price of macadamia differs throughout the seasons. Even within the same day, the price can drop as much as 40 shilling (Fieldnotes). In the brokers' SSIs we found that they could buy macadamia nuts at 140 or 160 shilling per kg at the same time (SSI 6; SSI 7; SSI 8). During a visit to the Limbua processing factory, a company representative explained how the quantity of nuts available on the market is the biggest challenge they encounter. With many different processing companies in the area, the pressure on the purchasing prices is high

(SSI 10). In that sense, it is the free market forces, the global demand on macadamia nuts, and the many actors interested in acquiring them, which causes the strong price fluctuations.

3.3 Macadamia farming strategies

In order to optimize the use of shambas which are smaller than one acre, farmers have turned to intercropping a variety of crops. Although famers with a bigger size of land would prefer not to (FGD). Figure 6 shows the crop cultivation distribution illustrating the diverse variety of crops found within a shamba. It is important to note that 100% of farmers grow coffee, and 94.4% of them grow macadamia. In regards to farming macadamia, farmers started planting macadamia trees on average six to ten years ago (Questionnaire data). Added to the fact that macadamia trees are relatively easy to plant and maintain (SSI 2), our results seem to suggest that planting macadamia was introduced as part of this intercropping farming strategy.

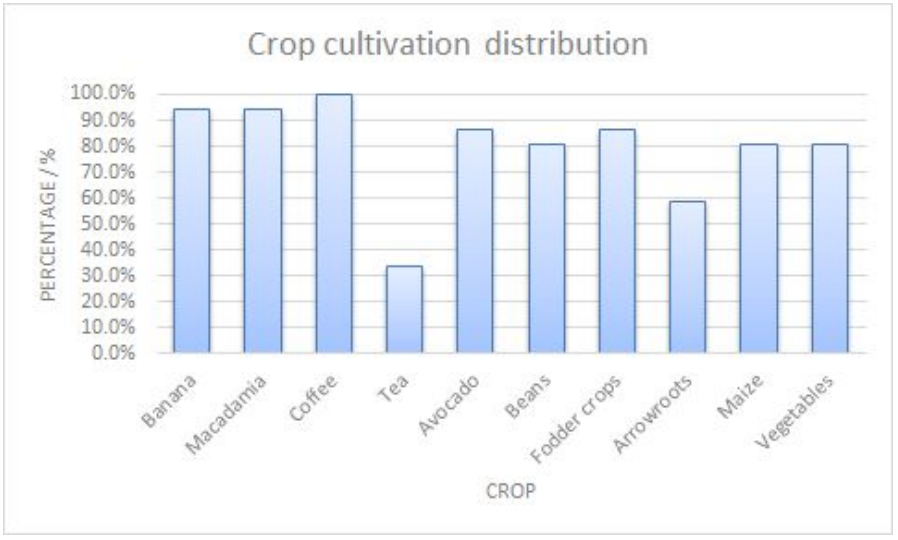


Figure 6: Bar chart illustrating the different types of crops Kibugu's farmers grow. Source: Questionnaire data

When acquiring macadamia seedlings, 36.1% of farmers obtain their seedlings through other farmers. 30.6% of farmers choose to buy their seedlings from companies. 8.3% of farmers are self-reliant and plant the seeds from their own macadamia trees. Only 2.8% use the services of agrovets, and another 2.8% purchase seedlings from brokers. According to the FGD, farmers buy or acquire their seedlings in August and prefer grafted macadamia (FGD). In average, it takes four to five years for the tree to flower, and the flowering time usually happens between September and February. January is the growing period for macadamia nuts, and harvesting occurs from March to May. In June, when the harvest is over, farmers prune their trees. Following the pruning, farmers administer cow dung and compost to fertilize their macadamia trees (Figure 7; FGD).

Month	January	February	March	April	May	June	July	August	September	October	November	December
Activities	Growing season of macadamia nuts	15th of February: Oficial start of Macadamia market										
	Flowering season continues								Flowering season starts			
			Harvesting season									
						Prunning						
							Composting					
								Acquisition of seedlings				
Challenges	Brokers buy macadamia nuts. Tetraphylla variety has thorns that hurt farmers duing harvesting.					Months where the falling of flowers is experienced as well as the attack from bush babies and monkeys (kithanda)			Early harvesting and theft starts taking place. Brokers provide low price to farmers who sell macadamia nuts during these months.			

Figure 7: Seasonal calendar based on the focus group discussion. Source: FGD

There are different harvesting methods farmers can choose from: wait for the nuts to fall to the ground, use a stick to force the falling of nuts, climb the tree, and shake the tree's branches. Farmers usually use a combination of these methods. For example, 80% of farmers who use a stick also climb the tree, and 62.1% of farmers who shake the branches also climb the tree. After climbing to the top of the tree, both the stick and shaking are used to force the macadamia nuts to the ground.

When looking at the people involved in the harvesting process, 50% of the respondents who use the stick method recorded this activity being carried out by hired labour. Hired labour was also attributed to 44.4% of the climbing and 19.4% of the shaking of tree branches.However, the labour used to pick up the nuts from the ground was the family (Questionnaire data). Given that using the stick, climbing the tree and shaking the branches is physically demanding, it makes sense that the elder farmers will hire people to help them out.

Picture 5: A macadamia tree during the harvest. Source: Fieldwork photos

The process that follows harvesting is dehusking. 58.1% of our respondents dehusk by putting the macadamia nuts in a sack and shaking it. The remaining 41.9% dehusk the nuts one by one using a stick or a stone. Given the relatively low physical labour needed in this activity, it is common to engage a family member (50%) rather than hiring someone else (46.7%) (Questionnaire data).

In terms of the strategy to prevent pests, one farmer noticed that as long as they kept a far enough distance between trees, monkeys and bush baby would not be able to jump between each other. Thus, they will stop coming into the farm (Participant observation). For mosquitos, some farmers use cow dung or burn pepper and Mexican Mengolah to smoke them away (SSI 2; FGD).

3.4 Market interactions

Even though the macadamia market is made up of different actors, we will focus on the three main actors in and around Kibugu; the farmers, the brokers and the companies. The farmers are the ones who grow and harvest macadamia (FGD). The brokers weigh and buy the nuts and then take them to the companies (FGD), whilst the companies grade and dry the nuts for further processing (SSI 10). These three actors engage in the production and trading side of the macadamia market. In the periphery of the market we have located the agricultural officer as she posses the administrative role of maintaining and improving the conditions for the farmers.

3.4.1 Interactions

The interactions between the different actors in the macadamia market are based on the exchange of money from macadamia. The agricultural officer is placed in the periphery as she has the capability to offer support. Figure 8 displays the relationships and interactions between the different actors.

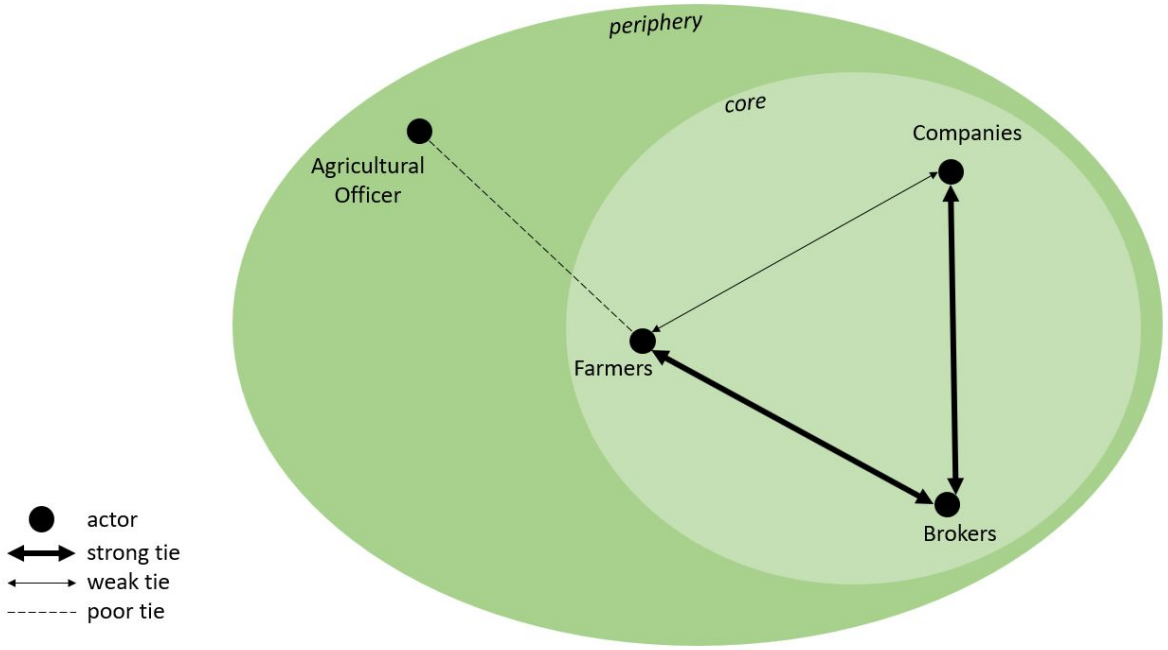


Figure 8: A visualisation of the macadamia actors' positions in the macadamia market in relation to each other including the strength of their ties. Source: SSIs, FGD

The bold lines display strong ties between the actors, and the arrows on both ends signal that the relationship goes in both directions. The relationship between farmers and brokers is exemplary of a strong connection. When considering these different ties, it becomes evident that the actors at the core of the network are the farmers, followed by the brokers and companies. We are positioning the agricultural officer on the periphery of the network as there is only a weak link that connects the government to the happenings of the industry.

3.4.1.1 Farmers and brokers

During the harvesting season, farmers interact with potential buyers for their macadamia produce. 97% of the farmers sell their macadamia immediately after harvesting (Questionnaire data). Figure 9 shows the different people farmers choose to sell their nuts to with 86.1% of farmers choosing brokers. (Questionnaire data). When selecting a broker, farmers choose the one who offers the highest price (FGD).

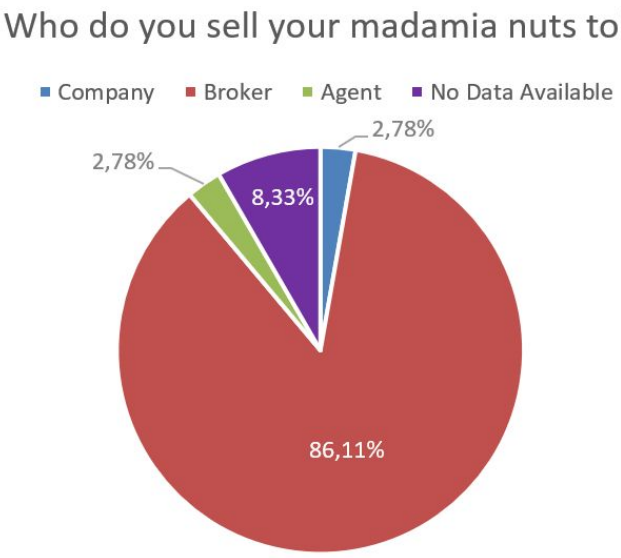


Figure 9: Share of farmers selling to brokers, companies and agents. Source: Questionnaire data

The relationship of farmers and brokers is characterised with different reasons for engagement: One farmer trades primarily with three brokers because of their existent friendship which benefits him in the transaction (SSI 4). Other farmers tend to use the same brokers for selling their macadamia based on previous successful transactions (FGD). The brokers' mobility is used by farmers to complete tasks for them. This includes harvesting and dehusking (Questionnaire fieldnotes). This connection between farmers and brokers for this transaction of goods and money is the strongest within the network. The transaction between brokers and farmers happens either at the farm gate (27.8%) or at the market (52.8%) (Questionnaire data).

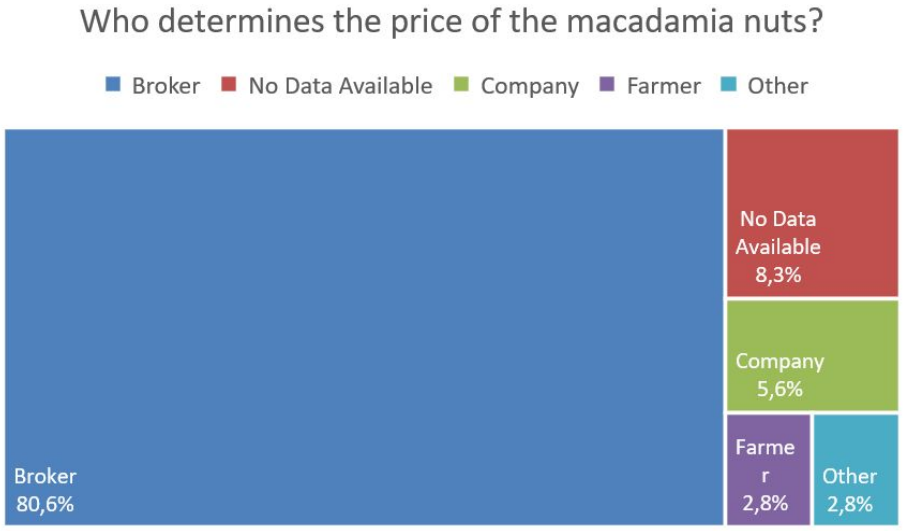
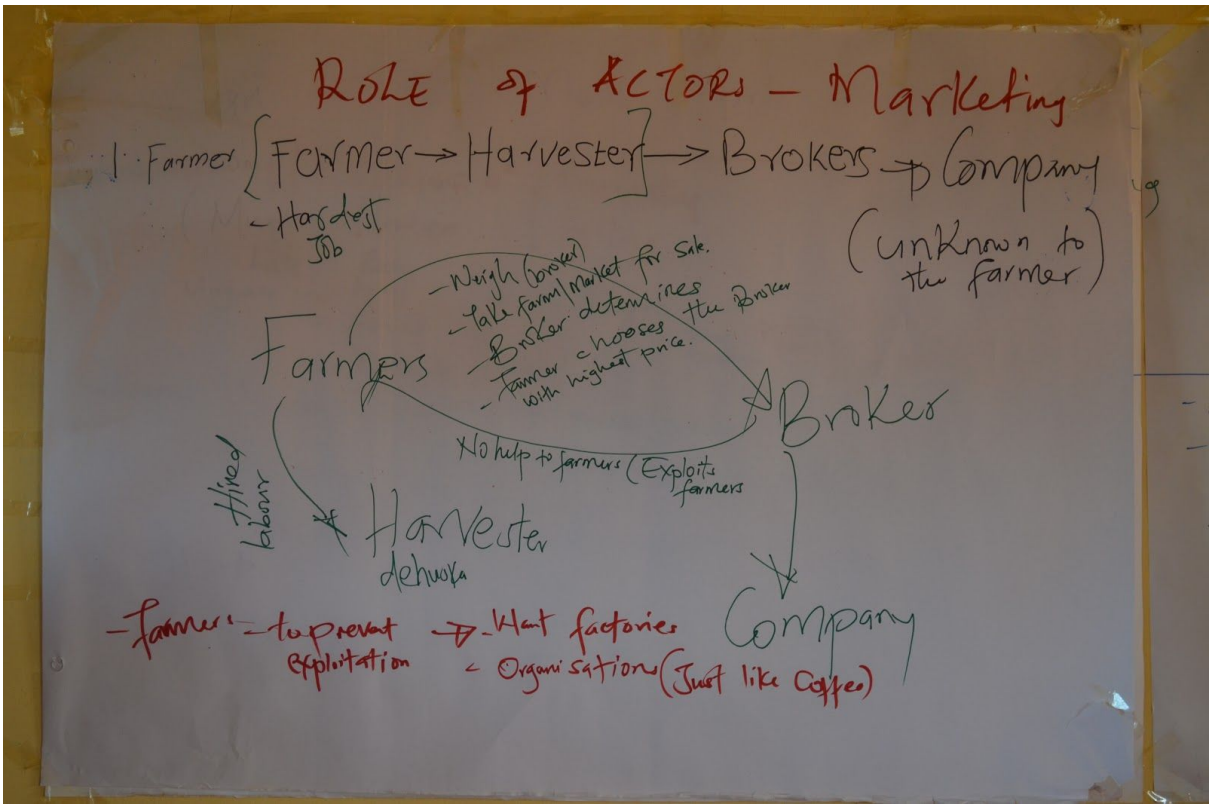


Figure 10: Treemap displaying the actors that determine the price of the macadamia nuts. Source: Questionnaire data

We also found that some farmers see brokers as a symbol for price volatility given that 80.6% of farmers perceive brokers as the ones who determine the price of the macadamia nuts (Figure 10

Questionnaire data; Focus Group; SSI 2). As a result of this dynamic, some farmers have become hostile towards the brokers and gave us statements such as “I think the macadamia market is overtaken by brokers” (SSI 2) or “Broker exploits farmers” (Picture 6; FGD).



Picture 6: The market structure as agreed upon by farmers during the focus group discussion. Source: Fieldwork photos

3.4.1.2 Farmers and companies

The purchasing of macadamia seedlings is the one interaction within the macadamia value chain where a considerably bigger portion of farmers interact with companies. As stated in a previous section, 30.6% of farmers buy their seedlings from companies. However, in regards to the sale of macadamia nuts, we found that only 2.8% of farmers sell their nuts directly to companies. This is why the link between farmers and companies can be considered relatively weak compared to the strong link that exists between farmers and brokers.

There are some companies in the area who prefer to seize their nuts directly from the farmers. The interaction of farmers with such companies is usually through contractualisation of farmers (SSI 10). Some of the benefits of this way of selling the nuts are that farmers receive basic training on macadamia farming, e.g. organic certification, and experience a relative price stability (SSI 10).

Picture 7: One of the companies seizing nuts from contracted farmers is Limbua. Here, a Limbua car is seen picking up nuts in the market place in Kibugu. Source: Fieldwork photos

3.4.1.3 Brokers and companies

Brokers act as mobile actors between farmers and companies. Therefore, the link between brokers and companies can be considered strong. Just as the farmer, the brokers are exposed to price volatility themselves. The price from the processing factories fluctuates throughout the season, and some brokers may be left with a storage full of nuts that they cannot make a profit on (SSI 5). Brokers also experience fraud when interacting with companies. Companies may delay the payments for the nuts, claiming they don't have cash at the moment and then never making these payments (SSI 5).

3.5 Livelihood assets

From the SLF perspective, the livelihood assets that the market structure demonstrates are mostly of social capital, as networks and connectedness are demonstrated through the strong and weak ties (Figure 9). These relationships of exchange reduce transaction costs. For some of the weaker and poorer connections, an increasing amount of trust is required to turn poor connections into strong ones and maximise the social capital of this interaction. E.g. the tie between companies and farmers. At the same time, the natural capital of the farmers could undergo improvements by strengthening the human

capital through better training and education on how to care for the land and plants. This is where the agricultural officer who is currently positioned on the periphery can contribute. Similarly, the physical capital in regards to the existent infrastructure suffers from a lack of communication as demonstrated by the contradiction of a plant clinic existing in Kibugu and many macadamia trees being affected by pests and diseases. Lastly, the financial capital is relatively week seeing that despite the recent increase in price, the price volatility still prohibits a regular inflow of money, which would be necessary for a strong financial capital. Concentrating on improving the assets that are particularly weak, especially the human capital, should be a strategy to improve the farmers' livelihood.

3.6 Institutions and organizations

3.6.1 Social relations as institutions

Social relations as an institution shape farmers choices in multiple dimensions. The first one is who do they sell their macadamia nuts to. Selling the nuts to the brokers is the preferred option (Questionnaire data) as brokers usually come to the farm to pick up the nuts. This decreases the transaction cost of farmers as they do not have to worry about transportation and storage. Although this choice is mostly arbitrary and driven by the price offer, some farmers prefer to sell to brokers who are also friends or relatives as stated above. Prioritizing selling macadamia nuts to kinship and friends is a rule followed by farmers which prevents them from being tricked and ensures that they will receive their payment. Secondly, the relationship that exists between brokers and farmers, is also what allows for early harvest of macadamia nuts to occur. Even though the official market period for macadamia nuts starts the 15th of February, farmers know that brokers will buy the nuts anytime of the year, which poses an opportunity of gaining cash even outside the formal market period. As such, farmers are incentivized to harvest even when macadamia nuts are not completely mature. The consequences of this are lower quality nuts which brokers still continue to accept. Thus, farmers engaging in early harvest is reinforced by the informal rule of brokers buying macadamia nuts throughout the year. Lastly, the theft of macadamia nuts, and the lack of response thereoff, can be explained by the relationship existing between farmers and the thieves. Although the theft itself is not well regarded and leads to frustration, a level of acceptance that macadamia nuts will be stolen is tolerated accepted as there is a personal connection with the perpetrators. This understanding leads to inaction from the farmer's side, and the idea of theft as an inevitable threat is perpetuated.

3.6.2 Payment in macadamia market

The macadamia market is characterized by quick movement. When asked about what the farmers do with their nuts immediately after harvest, 97% answer that they sell them (Questionnaire data). In that sense the nuts change hands from the farmer to the next link in the trading chain. As shown earlier, most farmers go to brokers when they sell their macadamia. In the brokershops the nuts from multiple farmers are compiled into the same gunny bags, thus losing the traceability back to the farmer (Fieldnotes).

Picture 8: Gunny bags full of macadamia being stored in a brokershop in Kibugu. Source: Fieldwork photos

The payments for macadamia nuts are made by cash or M-Pesa, an account accessible through cell phone service that allows you to deposit or withdraw cash. However, M-Pesas not connected to your bank account. As the farmers describe it, this is where macadamia differs from other cash crops; They provide "instant cash" (SSI 2; FGD). M-Pesa payments are prefered by companies or agents buying macadamia whereas most brokers pay by cash. Besides being fast, cash payments allow the brokering business to operate without any traceability. It has the advantage of allowing the farmers to sell at any time, when they need cash (SSI 1). However, this payment method also has its disadvantages. As one farmer describes it "It [the payment] doesn't go to the bank it goes to the pocket – to the tusker" (FGD). The downside on the other side is that the payments are not structured – allowing the farmers

to use them instantly and not plan the way they spent it. Besides, it is hard for farmers to record the income from macadamia nuts, thus they could not capture the price fluctuation incisively and then make decision to sell nuts when the price is relatively higher in the next year.

In order to understand how cash payments impact the farmers it is important to understand how the biggest cash crop in the area, coffee, is traded: The coffee is sold to local cooperatives. Here, the amount of coffee submitted is registered during the harvest season in December and then payments are made in May when the coffee has been processed, sold and the quality of the coffee has been determined (Transect walk; SSI 3). The money is then transferred to the farmers' bank accounts. When payments are done in this way, farmers can prove that they have a stable income from the cash crop, which situates them in a better position to take out loans (FGD). In this context, we will argue that the mode of macadamia nuts payment shapes the the current market structure; The benefits from the instant payment make the lack of transparency of the market acceptable

3.6.3 Lack of information

During the SSI with the agricultural officer of Embu, we acquired the knowledge that government through the Ministry of Agriculture, has established a plant clinic in Kibugu. This clinic provides the services of consultation, crop and soil sampling, technical guidance, and farm visits (SSI 1). However, the perception the agricultural officer has in regards to her outreach with the farming community is not reflected in our data. Out of all the farmers from our questionnaires, only 16.7% had received extension services, but none were provided by the government (Questionnaire data). Thus, there is a contradiction between farmers' perception of lack of support from the agricultural office, and the agricultural officer's self-conception. When asked why this is the case, the agricultural officer pointed out that farmer's themselve are a challenge as she believes that "farmer don't feel like they need to be taught how to plant". This is informed by the low turnout she receives during the training workshops (SSI 1). Farmers on the other hand, believe that when the government intervene, it is due to their personal agenda and an intention to take part of the revenue. Hence why farmers do not attend these workshops in fear of taxation (SSI 1). This situation leads to mistrust which becomes a barrier for farmers accessing the existing resources for knowledge and information. Given the weak link and lack of trustworthiness between the agricultural officer and farmers, sharing knowledge becomes problematic as it is dependent on the willingness of both actors to interact. Creating a stronger tie would require both the agricultural officer and the farmers to invest time and energy into establishing some conversation and trustworthiness.

In 2018, flowers started falling off the trees prematurely (SSI 4), which has significantly lowered the macadamia yield. The phenomena of the falling flowers does not have a homogenous

explanation among the small-scale farmers. The falling flowers have been explained as caused by heavy rains and cold weather (SSI 3), “God’s will” (Questionnaire fieldnotes), ‘mosquitos’ attacking the flowers during flowering, and its caterpillars growing in the young nuts (FGD). When this issue was presented to the Agricultural Officer, she explained how this was due to a stink bugs attacking the tree, and the problem could be relieved by spraying with an insecticide called ACTARA (SSI 1). Given how Christianity is a big part of everyday life and a way to approach problems, the religious explanation makes sense. With the lack of knowledge on the natural processes of farming macadamia, the role of religion can cause farmers to identify problems they cannot explain as God’s will. This may lead to not taking action from the farmers’ part, compromising the achievement of maximum yields.

Picture 9: A flowering macadamia tree. Source: Fieldwork photos

3.6.4 Legislations

The official market time for macadamia opens February 15th each year. This marks the annual start of the macadamia processing season, a law introduced by the Kenyan government. This represents an institution, rooted in law. According to the agricultural officer, the current macadamia policy is not sufficient and no new policy is in the process of being developed (SSI 1). Even if it were, it would take a long time to be passed and might not be implemented after all (SSI 1). A law that was introduced in 2009 banned the export of raw nuts, subsequently adding value to the supply chain in

the local macadamia market and giving way for macadamia processing companies. Both of these policies influence and have influenced the structure of the market and support the way it is now. Generally, the fact that there is no certification for macadamia nurseries and seedlings provision required, no control or certification within the brokers, and no legal enforcement of farming practices means that the macadamia market is governed by rules that are mostly informal and not rooted in law.

3.7 Livelihood outcomes

For Kibugu farmers, a livelihood outcome arising from farming macadamia is an increase in income. Even though coffee is the most important cash crop in the region (SSI 6; SSI 7), and it is grown by all our interviewed farmers (Questionnaire data), macadamia is considered the second most important cash crop (SSI 6; SSI 7). This makes macadamia an important additional source of income. Unlike coffee, from which farmers obtain a payment once a year, macadamia can be traded at different points in time (SSI 2). In that sense, macadamia covers farmers immediate needs as they can harvest a few kilograms, sell it immediately in the market, and receive the payment instantly (SSI 2). A farmer pointed out how this form of trading allowed to secure food on the table (SSI 3) while another explained how the income from macadamia is also used for paying education fees (SSI 4; SSI 8). Income security is also achieved through the crop diversity within the shambas. By growing multiple crops, farmers' vulnerability to price fluctuations is decreased as the different growing and maturing times allow them to sell the crops at different seasons of the year.

The outcome from a market structure characterized by instant payments and the lack of transparency has led to theft becoming a big problem for macadamia farmers. The stealing of macadamia nuts can be done by anyone passing by the trees. The fact that this is often done by family members (Fieldnotes from questionnaires) brings mistrust and disbelief to the community.

Better quality and yield of macadamia and coffee is another livelihood outcome that can be achieved through intercropping. Intercropping both crops is beneficial for their production (Perdoná & Soratto, 2015), which farmers have confirmed by saying that the shade from macadamia trees results in healthier coffee (FGD). At the same time, intercropping macadamia with other crops is a way to utilize the land more efficiently as the different rooting ability and nutrient requirements allow for complementary resource use (Lithourgidis, 2011). Through our participant observations, we observed farmers intercropping macadamia with crops that have different height. This practice increases the efficiency of sunlight use as presented by Yulaswati's research (2004). Farmers also mentioned using the same fertilizer and pesticide of coffee on macadamia. Thus, they do not have to invest on an extra input that is specific to the macadamia crop.

3.8 Opportunities for the future

Coffee farmers in Kibugu are organised in coffee cooperatives, which coordinate the market structure of coffee. Macadamia farmers, however, are not organised in this way. Currently, none of the macadamia farmers are organised as no such organisation exists (Figure 11).

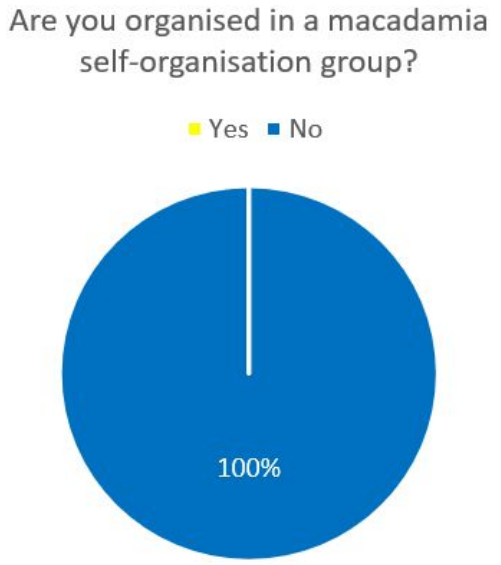


Figure 11: Share of farmers organised in a macadamia self-organisation group. Source: Questionnaire data

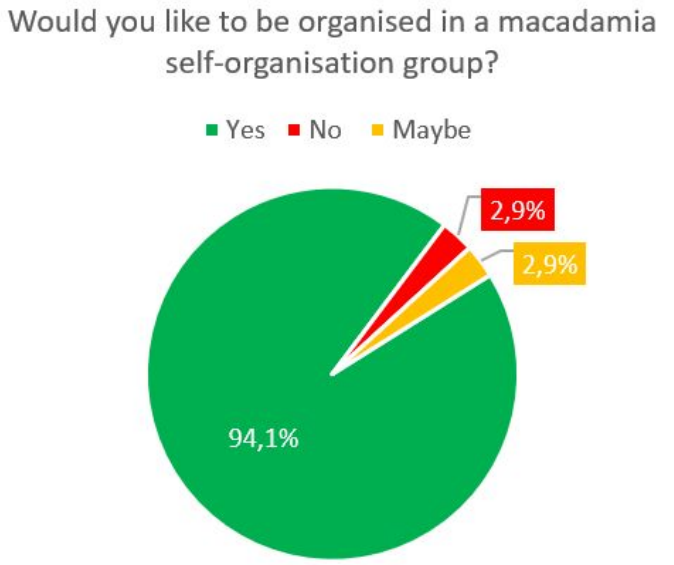
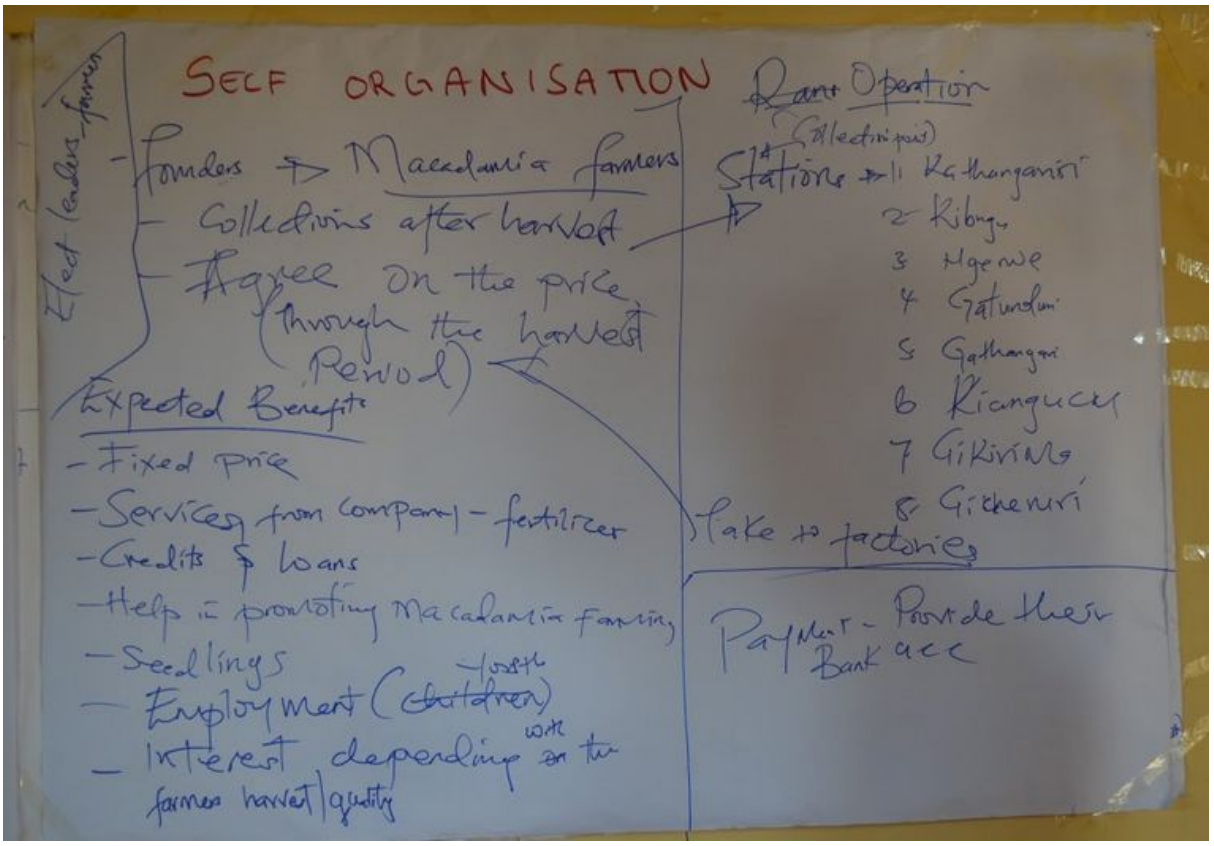


Figure 12: Share of farmers interested in being organised in a macadamia self-organisation group. Source: Questionnaire data

However, 94.1% of farmers would like to be organised for growing macadamia, whilst 2.9% are against and 2.9% are indecisive on the matter (Figure 12). Knowing the significant interest in self-organisation groups led us to ask why this type of organisation has not been established yet in the following SSIs. One farmer recounts that attempts of forming a group have not been successful because of disagreement amongst the farmers regarding the rules of the group (SSI 3). Another farmer believes that there is a lack of leadership, with no one being brave enough or capable to start such a group (SSI 2, FGD). This farmer also explained that there is disbelief and mistrust amongst the farmers which leads to a lack of unity and support (SSI 2). On a more practical note, another farmer stressed that macadamia only became commercial ten years ago (SSI 4) and therefore not enough time has passed for structures to be established. This feedback was presented to the farmers of the focus group and they were tasked with imagining how a possible structure of a self-organisation group could look like. Besides being founded by macadamia farmers and electing the leaders of the organisation amongst themselves, an operational structure of eight nut collection stations in different parts of

Kibugu was proposed as the possible structure (Picture 10). The expected benefits of a self-organisation group range from fixed price, credits and loans to services regarding fertilizers and seedlings, employment opportunities and possible interest/ bonus payments (Picture 10).



Picture 10: Farmers ideas for a self-organisation group gathered during the focus group discussion. Source: Fieldwork photos

Based on the expected benefits of fixed prices, credits and loans from the self-organisation group (Picture 10), this could serve as an opportunity to stabilise the financial capital through regulating the inflow of money by agreeing on a price and supplying credits and loans. The chance to influence price mechanisms, which currently are controlled by the external environment that are brokers and companies, through collective bargaining means that farmers can interfere with the price volatility and relieve themselves of the vulnerability that the current structure imposes upon them. A self-organisation group for macadamia farmers could also create employment of the youth of Kibugu, consequently strengthening the human capital through education, trainings and employment. The provision of seedlings and fertilizer through the self-organisation group means that the natural capital of farmers could be developed. Therefore, a self-organisation group could strengthen the livelihood assets and could function as a livelihood strategy where farmers cooperate with each other to achieve their common goal of a sustainable livelihood. By taking control and joining forces, farmers can reduce their vulnerability to price through collective bargaining, come up with strategies to manage

pests through collectively voicing their issues to the responsible ministries and find coping mechanisms to deal with external circumstances such as the climate.

4. Discussion

4.1 Improvement of livelihoods

Previous studies on the field of macadamia have shown the increase of popularity for this crop over the years. Gitonga et al. found that the increasing prices of macadamia nuts were driving farmers towards producing macadamia as a cash crop (2009); A trend that is still relevant today. From 2017 to 2018, the price went from 70 to 180 KSH/kg (Gebre & Nyambura-Mwaura, 2018). This increase in price matches our findings. However, what the studies do not expand upon is the price volatility within the market. We found that the price of macadamia nuts not only follows the pattern of harvesting and growing season. There are variations within even one season as farmers are offered deals with different conditions. For example, in March 2018, the same kilogram of macadamia nuts could be sold at 40 or 180 KSH (Questionnaire data). Not understanding how or why prices change is a source of frustration for farmers in Kibugu. This is why many farmers would prefer to have a set price throughout the season in order to be able to plan and predict the income that is solely coming from macadamia (FGD). Additionally, when farmers were asked if they would be interested in planting more macadamia trees, our question was uniformly met with a positive answer. The justification behind this choice is the additional source of income that they would obtain. We have therefore found results supporting the arguments and tendencies described in previous studies.

From our literature review we found multiple sources stating that macadamia has potential for reducing poverty due to its high prices (Embu County Report, 2016; Garguilo et al., 2010) . The same perception was shared by the agricultural officer (SSI 1). What we found in the field was that the income from macadamia doesn't reach its full potential for poverty reduction. This is due to two things. One is the method of payment that doesn't allow for farmers to take loans in banks, as they can't prove transfers from macadamia income when they are paid in cash or M-Pesa.

An interesting contradiction between the literature and our results is the perceived availability and accessibility of extension services. On one hand, the Ministry of Agriculture is responsible for providing these services (Embu County Report, 2016) and literature suggests that farmers are seeking help from agricultural officers as well as benefiting from workshops and trainings (Nambiro, Omiti, Mugunieri, 2006). However, our results show that farmers do not receive any extension services from the agricultural officer at this point in time. So, even though the farmers express a need to be trained,

the few extension services they receive are from private companies. The agricultural officer does not seem to believe in the farmers' willingness to be trained (SSI 1). This demotivates the agricultural officer from putting more effort into reaching out to the farmers. We would, therefore, argue that the available resources are currently inaccessible to farmers. Nambiro, Omiti and Mugunieri (2006) also argued that whether a farmer received extension services depended on the household head being male and achieving a high level of education. Yet, our results show that the respondents who received trainings have varying levels of education and are mostly women (Questionnaire data).

4.2 Improvement of farming practices

According to the literature review, the macadamia production does not reach its potential yield, due to a lack of information and knowledge on management practices (Sato & Waithaka, 1998; Mburu et al., 2016). This is supported by our findings that suggest that farmers lack knowledge on planting macadamia. Even though they want to obtain knowledge on the most lucrative farming practices for macadamia, there is a problem to access it. Specifically, farmers lack knowledge on the natural processes of macadamia; for example, the appropriate methods of pruning (Wilkie et al., 2010) or the benefits from cross-pollination among different macadamia varieties (Trueman, 2013). Thus, in order to maximize their yield, farmers should ensure a population of active pollinators and high carbohydrate availability during early fruit development (Trueman, 2013). Yet, in our research, none of the farmers mentioned awareness of the importance of pollinators and carbohydrate availability. Instead, they only requested more information on pesticides, fertilizers and cultivation practices (Questionnaire fieldnotes). As such, we would like to suggest that the falling of the flowers could also be attributed to the lack of pollinators and macadamia's low self-compatible rate (Urata, 1954). If this were the case, the problem could be solved by planting different varieties in same farm and planting flowers that attract pollinators, the main one being the honey bee (Howlett, 2015), along the macadamia trees. During our data-collection we were met with farmers asking questions on practicalities, such as which fertilizers they could use (Questionnaire fieldnotes). Which express the desire among the farmers to enhance their production. As we didn't meet any farmers with a strong knowledge on how to look after macadamia, it is hard for the community to cover this need of knowledge within itself.

We also found that in certain situations, farmers may have the knowledge but are incapable of bringing into action. For example, farmers are aware of the fertilizers or pesticides they can use for their macadamia trees. However, they don't always have the money to buy them (FGD). Additionally, given that macadamia trees are tall, a special spraying machine is needed for this activity which is also expensive (Fieldnotes from questionnaire).

4.3 Criticism of the SLF approach

The Sustainable Livelihood Framework (SLF) is beneficial for understanding the factors that influence people's livelihood strategies. Hence, using this framework has been useful to understand the local situation of the macadamia market in Kibugu. However, this framework also has its own limitations. The SLF leaves little space for the individual agency as people's actions become a product of external factors and the assets they possess (Scoones, 2009). This issue is illustrated in our study as we grouped the main actors in order to describe their general strategies. However, we also met many inspiring farmers and brokers who adopted unique strategies to improve their livelihoods. These examples show the limitation of grouping actors and the level of analysis that can be reached. Moreover, even though the SLF strives to capture the complexity of the field, it contains reductive predefined categories that limit the scope for each component. Hence, what is of importance in the field and the way you should approach it, is already predefined. However, in our field it was not as fruitful to do an assets analysis as it was to look at institutions and organizations.Furthermore the framework takes a range of environmental aspects into consideration, which we haven't looked at in the field and that it is hard to do a complete assessment of. When conducting fieldwork for a limited period of time, looking at all components of the framework can take away focus from going in-depth into the main area of the study.

4.4 Reflections on methods

Reflecting on the success and downfalls of our methodology, the language barrier should be noted as a detriment across all methods. Questionnaires and SSI were generally carried out in the local languages; Kiembu or Swahili, and our local guides and Kenyan counterparts were very helpful with translating farmers' answers. However, some data was lost in the process as the translation may lead to wrong interpretations or misunderstandings. Aside from the issue of translation, there were times when the local guides would answer for the farmers depending on what they observed from the farm and its surroundings. Hence, some of the answers did not come directly from the farmers but rather were the guides' interpretations. The challenge in the FGD was that we were unable to follow what was happening during the discussion in real time. However, even though we might have missed some information, less information would have been gathered if the FGD had been conducted in English.

We received a very low turn-out during the FGD. With only four attendants our guides became an active part of the discussion which was not intended. The farmers that came were motivated to participate and brought a lot of value to the discussion. The lower numbers of

participants created a more intimate space which allowed for an environment of trust and openness to be created. Looking back, the data gathered through this method was one of the most valuable in the research process as it brought all previous knowledge together. As part of the FGD, the PRA methods seasonal calendar and ranking matrix were used. The execution should have been farmer led, but this was difficult to carry out.

4.5 Reflections on our group work

During our field work we had a few issues adjusting to the different academic approaches posed by our Kenyan counterparts and supervisors. We found that the Kenyan supervisors were hardly ever questioned by the Kenyan students and tended to take control of our discussion, which made the process tedious at times. During the supervision meetings, discussions tended to focus on less relevant topics and valuable time was lost. Additionally, our perception of etiquette differed greatly from our fellow students. It was quite common for our Kenyan counterparts to pick up calls during our meetings and when conducting the fieldwork. We feel like this conduct disturbed our work and performance, and we regret not bringing this issue up with them to solve it.

5. Conclusion

The different sets of institutions and organizations within the macadamia market present an interesting dichotomy. These institutions give farmers the freedom to navigate the market in a way that benefits them the most; as when farmers sell to their friends to maximise the outcome. However, the lack of regulatory framework has also allowed for a multitude of actors to engage in activities that destabilize the structure of the market. Under these conditions, farmers become more vulnerable and unable to achieve a stable income.

For macadamia farming to reach its full potential, the different assets that farmers posses should be strengthened. Therefore, the livelihood strategy of farmers should concentrate on improving those assets that are particularly weak, especially the human capital. This asset is indispensable for the other four capitals to prosper.

The challenges within the macadamia market can be divided into two components: The structural limitations and the lack of information. Currently, the lack of formal rules leaves the market open to be governed by informal rules. These informal rules are directed by the actors' individual agendas. As a result the market becomes competitive which enables cheating and mistrust. All in all, the market has become rigid and hostile to change. Farmers' lack of information regarding appropriate macadamia farming practices has less to do with the availability of resources and more with their

accessibility. The premises on which extension services are given are not clear to the farmer, leaving both farmers and the agricultural office in a waiting position where no-one takes action.

Overall, it can be argued that macadamia farming is a profitable and low labour intensive farming activity. The macadamia farming helps to improve the livelihood of small-scale farmers by bringing additional income to the household. However, the potential of macadamia farming has not yet been reached. This could be achieved by developing better farming practices through strengthening existing assets and building a better market structure. In order to support a sustainable development of the macadamia industry in Kibugu, we advice the provision of trainings on better farming practices. This would secure a higher yield and better quality of the nuts. One way to create change for farmers in Kibugu would be by establishing a self-organization group to improve the market structure and improve the infrastructure for trainings. The group could serve as the contact point between agricultural officer and farmers.

A challenge that remains unexplored is the dependency on the continuously rising demand of macadamia on the world market and the impact that a potential crash would have for farmers. Given the scope of our study, we were unable to look into resilience mechanisms for macadamia farmers and the outcomes from shifting to a full-scale macadamia production. Future studies would benefit from tackling these topics as well as focusing on what the impact on the livelihood of macadamia farmers would be as macadamia continues to gain popularity in Kibugu.

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Appendices

#1 Table of Methods

Method	**Quantity**
Questionnaire	36 respondents
Semi-structured interviews	11 respondents ● SSI 1: agricultural officer ● SSI 2, 3 and 4: farmers ● SSI 5, 6, 7 and 8: brokers ● SSI 10: macadamia company representative
Focus group discussion	1, with four participants (3 male, 1 female)
Participatory Rural Appraisal	2, as part of the FGD ● seasonal calendar ● ranking matrix
Transect Walk	During the questionnaires and SSIs, transect walks across farms were taken with farmers and during our time in Kibugu, transect walks with our guides within the community were taken.
Participant observation	Participant observations were conducted as we were staying in the town. Though our main participant observations took place in the houses of our 3 host families, where we participated in daily life activities. Besides the families we conducted participant observations on the market and on the farms observing transactions and practices concerning macadamia.

#2 Questionnaire Guide

We are students from the University of Nairobi and the University of Copenhagen. We are doing a study on the challenges and opportunities regarding macadamia nuts production and marketing. In order to understand the macadamia farming in Kibugu we would like to ask you a series of questions. The results will be treated confidentially and will be used in our report and a possible publication. We will make a presentation on our findings on the 11th of March to which you are kindly invited to.

Are you okay with us using your responses in our study and a possible publication?
May we take photos of you and your farm for our study? Can we also use them in our publication?

Demographics

1. Name of respondent:_____
2. GPS-Waypoint:_____
3. Age: _____ years
4. Gender:

Male	
Female	

5. What's your level of education?

Primary	
Secondary	
Tertiary	

Objective questions

6. Is farming your main source of income annually?
Yes ____ No _____

7. Besides farming what other sources of income do you have?
_____

8. How long have you been a farmer? _____ years

9. How many shambas do you have and how big are they?

Location	Size in acres

10. Which main crops do you cultivate on your farm?

Banana	Macadamia	Coffee	Tea	Beans	Maize	Vegetables	Arrowroots	Fodder crops	Avocado	Khat	Sweet potato

Other:_____

11. If you do not grow macadamia, what are the reasons for this?

_____

_____

_____

Thank you for your contribution to our study. We appreciate your help greatly.

Questions concerning macadamia

12. When did you start macadamia farming? _____ (year)

13. Can you provide us with information regarding the species of macadamia trees you grow?

Variety	Macadamia Integrifolia / Mugumo / Embu 1 / Kiambu 1	Macadamia Tetraphylla	Grafted macadamia
Which do you farm?			
No. of trees			
Years to maturity			
Yield per year			

14. From whom do you obtain macadamia seedlings?

Brokers	Other farmers	Factories/companies	Agrovet

15. How many kilograms of nuts did you produce last season? _____ kg

16. How many kilograms of nuts did you sell last season? _____ kg

17. Do you intercrop your macadamia trees?
Yes ____ No ____

18. If yes, what crops do you intercrop the macadamia tree with?_____

19. Do you use pesticides/insectides on your macadamia? Yes _____ No _____

20. How do you harvest your macadamia nuts?

Method	Yes	Who does it
Free fall		
Using a stick or hook		
Climbing		
Shaking the branches		

21. How many people are involved with the harvest? _____

22. How do you dehusk? One by one: _____ By sack: _____ Machine: _____

23. Who dehus? Brokers _____ Hired labour _____ Family _____

24. What do you do with your macadamia nuts immediately after harvest? _____

25. At which price did you sell your last harvest for?

Time period	Price in KSH/kg

26. Who do you sell your macadamia nuts to?
A company _____ Brokers _____

27. Where do you sell your macadamia nuts?
At the farm _____ at the market _____

28. Who determines the price of macadamia nuts?
Farmer _____ Broker _____ Company _____ Other _____

29. Do you get any support services for your macadamia farming?
Yes ____ No ____

30. If yes, which support services are these?

Support services	Which ones?	From whom?

31. Which threats do you encounter during your macadamia production?

Theft	Pests	Brokers	Lack of information	Weather/ climate	Others

32. Are you organized in a macadamia cooperative/ macadamia farmers' organization?
Yes ___ No ____

33. If no, would you like to be in a cooperative? _____

Are you interested in a follow-up discussion/interview? _____
If yes, kindly write your phone no. _____

Thank you very much for your time and input.

Do you have any questions or comments in regards to this series of questions?

#3 Farmers SSI Guide

(Start with chit-chat and remind farmers of the purpose of our study, confidentiality and all for permission to use results and record the conversation)

1. Who introduced you to macadamia farming?
    a. Did you get your seedlings from them?
    b. How did you learn how to cultivate macadamia?
2. Why do you intercrop macadamia?
3. *Pesticides use: Check questionnaire answer beforehand to know which question to ask.*
    a. If you do not use pesticides, why?
    b. If you use pesticides: why, how and which?
4. How do you get the information on the current market price on macadamia?
5. For which purpose do you do macadamia farming? (E.g. retirement, extra income)
    a. Can you rank these crops from most to least important in value for you?
        i. *PRA: Ranking exercise:*
            1. *Prepare post-its with English & Kiembu names*
                a. *Tea*
                b. *Coffee*
                c. *Macadamia*
                d. *Avocado*
                e. *Banana*
            2. *Hand the post-its to farmer to organise*
            3. *Take a picture of the results & note it down*
            4. *If there is time, ask for price and yield of the most important crop and macadamia in order to be able to compare afterwards*
    b. Do you plan on planting more macadamia trees? Why/ Why not?
6. After which time are you able to have a consistent income from macadamia?
7. Have you ever received any help from the government, institutions, companies, interested parties, NGOs?
8. Have you ever taught other farmers something about macadamia farming?
9. Can you rank the following challenges. On this scale, make a mark where you think the challenge is?

    Not bad----------very bad

    (1)theft (2)pests (3)brokers (4)lack of information (5)weather/climate
10. What can you do against theft?
    a. Could secure storage help?
11. How do you choose a broker?
    a. Have you switched brokers and if so, why?
    b. Would you prefer to sell to a company instead of a broker if possible?
    c. Which kind of payment do you prefer?
12. Why do you sell your macadamia immediately after harvest?
13. Are there any differences in price for Mugumo and Traphylla?
14. How do you like being in a coffee cooperative?
    a. What are the benefits/ disadvantages?

15. Why has no cooperative for macadamia been established yet?
16. Could a cooperative help with the theft of macadamia?

#4 Brokers SSI Guide

Theme	Questions
Presentation	Presentation of our study. *What's your name?* *Age?* *What do you do besides macadamia broking?* *How long have you been a macadamia broker?*
Role of macadamia	*What got you into being a macadamia broker?* *How would you describe the impact macadamia has on the community?* - *Values, risks* *What are you activities in the macadamia market?* - *Do you also farm macadamia?* - *How would you describe the value of your services on macadamia?*
Knowledge	*How do you get knowledge regarding macadamia?* - *Pricing?* - *Farms to buy from?* *How do you share knowledge between brokers?* - *Setting the price?* - *Weighing?* *Do you believe brokers are beneficial for the market?* - *Why?* *Do you know any pesticides for macadamia?*
The macadamia market	*How would you describe the macadamia market?* - *What is your role in it?* - *What are the main challenges?* - *What is your risk perception of the market?* *What do you do immediately after buying the macadamia?* - *Which factories do you sell to?* - *Are there different buying prices at different factories?* *What do you think of the market period?*

	How do you assure that you buy nuts of quality? - *Do you think that you/ the farmers lack knowledge on assuring quality?* - *How could you get that information?* - *When you take the nuts to the factory, then how many are rejected?* *How do you make payments?* - *Cash, credit, mpesa…*
Cooperatives	*Which impact would it have on the macadamia market to have a cooperative for macadamia in Kibugu?* - *On you operation?* - *Would you support a cooperative?* *How are you organized as brokers?*

#5 Agricultural Officer Guide

- What does your job entail?

- What does the agricultural department do?
    - What are the specific policies and plans for the macadamia sector?
    - Are there any initiatives for the farmers in regards to support services?
    - If you have plans, how do you ensure that they will be carried out?

- What do you think that macadamia brings to the farmers?
    - Have you seen an increase in production in the last years?
    - What are the reasons for this?

- What are the main challenges of macadamia production?
    - What are the main challenges for the farmers?
    - How do you know about this challenges?

- What are the challenges that the farmers most frequently report to the agricultural office?

- We heard from a lot of farmers that flowers fall down before bearing fruit. Why do you think that is?

- What is your perspective regarding monkeys, bush babies and mosquitoes?

- What are the main challenges within the macadamia market?
    - What would be the ideal market structure?

- What is the role of the broker in the macadamia sector?

- Do you think it would be beneficial for macadamia farmers to be organized?
    - Why?

- Do you do you foresee any obstacles in the creation of these organizations?
    - Why do you think there is no co-operative for macadamia?
    - What would be the outcomes of such co-operative or organization?

#6 Company SSI Guide

Can you start with a presentation of yourself and the Limbua group?

- What differs you from other macadamia processing companies?
- How do you obtain the nuts from farmers?

What does it entail to be an organic farmer?

What do you do to the nuts here at the factory?

- What do you do with the nuts that aren't suitable for consumption?

How do you ensure a high quality of nuts?

Can you expand on the topic of trainings provided to the farmers?

How would you describe the macadamia production?

- What do you pay the farmers for the nuts?

How many people do you have employed at Limbua?

- Where are they from?

Why do you think there is no organization for macadamia farmers, like there is for coffee?

What are your biggest challenges as a company?

What are your plans for the company?

#7 Focus Group Discussion Guide

1. Introduction: Feel free to use the language you feel most comfortable with.
    a. Round of introductions - Annika
    b. Explanation of the purpose of the study - Signe
    c. Confirm confidentiality & get consent on voice recording and photo taking - Annika
2. Seasonal Calendar - visual exercise with blank paper on the wall
    a. Thank you for all the information from the questionnaire. We would like to understand more about
        i. the production throughout the year
        ii. harvest period, selling period
        iii. threats/ challenges
3. Pesticides
    a. Falling of the flowers
        i. Why do they fall?
        ii. What can be done to prevent it?
    b. Holes in the nuts
        i. Why do the nuts have holes?
        ii. What can be done against it?
4. Market structure - visual exercise with blank paper on the wall
    a. Goal: Understand the role of the actors and the interactions
5. Self-organisation groups
    a. Suppose there would be a new self-organisation group for macadamia, how would you want it to be formed and how would you like it to be run?
6. Intercropping (might get dropped if we run out of time) - visual exercise with post-its and scale on paper
    a. What happens when you intercrop?
    b. Use post-its for answers and put the on the scale from very bad to very good
7. Varieties (might get dropped if we run out of time) - poster exercise
    a. Which varieties are there?
        i. What are the advantages?
        ii. What are the disadvantages?

Synopsis

Going nuts - Macadamia farming and trading in Kibugu, Embu, Kenya

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Introduction

Agriculture has always played a major part in Kenya's economy as farmers constitute the larger part of the population, and account for 61.1% of the labour force (CIA, 2019). The export-oriented agriculture is a key industry in Kenya and one of the main sources of income. One of the key agricultural exports of Kenya is the macadamia nut (Mbora, Jamnadass, Lillesø, 2008). Macadamia integrifolia is an evergreen tree in the flowering plant family Proteaceae, native to Queensland Australia. The tree was introduced to Kenya in 1944 and is mainly used to provide canopy shade to coffee and serve as an extra income to farmers (Mbora et al., 2008). The leading districts for macadamia plantation are Meru, Embu, Kirinyaga and Thika (Muthoka et al., 2008). In recent years, the price of macadamia has increased, from 70 shillings in 2017 to 180 shillings per kilogram of macadamia shelled nuts in 2018 (Gebre & Nyambura-Mwaura, 2018). An increasing number of farmers are now focusing on the production of macadamia nuts as a cash crop (Gitonga et al., 2009). 10% of the world's macadamia production is based in Kenya which grants the macadamia nut is a great potential for poverty reduction (Mbora et al., 2008).

In Embu County, macadamia is one of the dominating crops alongside coffee, tea, bananas, beans, sorghum and livestock production (Mburu et al., 2016). According to Mbora et al. the macadamia nut tree in Embu County is a hybridisation between the Macadamia integrifolia and the Macadamia tetraphylla called EMBU 1. Generally, macadamia trees grow best in fertile and well-drained soils which is the case in Embu County. The altitude, the mean annual temperature between 10°C and 30°C, and the mean annual rainfall of 640 mm in Embu county, are all optimal conditions for the macadamia trees. The macadamia industry involves more than 100,000 small scale farmers that use macadamia nuts to diversify their production (Mburu et al., 2016). Macadamia trees require minimal care from the farmers, and when intercropped with the staple crops, they become a profitable source of income (Mbora et al., 2008). The study of Mburu et al. found a correlation between the farming of macadamia and the reduction of poverty among Embu's small-holder farmers (2016). Presently, Embu County supports farmers in purchasing macadamia seedlings aiming to expand the county's macadamia production and quality (Embu County Report, 2016).

Problem Analysis

Given the increasing demand for the macadamia nuts, the production is put under pressure and expected to increase accordingly. However, even with the encouragement and support of the government, the production of macadamia nuts is far from reaching the potential yields of the crop (Sato & Waithaka, 1998). This is partly because the inadequate infrastructure for the nut processing. There is also a scarcity of scientific information on appropriate crop management techniques, and knowledge on pest and disease control (Sato & Waithaka, 1998; Mburu et al., 2016; Mbora et al., 2008). In 1974 the Kenyan Nut Company (KNC) was founded by the government to invest in the expansion of the macadamia nut industry in Kenya (Sato & Waithaka, 1998). Ideally, KNC would oversee the local production and processing of macadamia, while the Kenyan Agricultural Research Institute (K.A.R.I) would oversee the research of the macadamia crop (Sato & Waithaka, 1998; Gregoratti, 2011). As the state has implemented two separate institutions working on promoting the Kenyan macadamia industry, it could be assumed that their efforts are not always coordinated. K.A.R.I has also been recipient of many complaints alleging that not enough support is given to the macadamia crop research to impede the industry's development (Sato & Waithaka, 1998). The

national institutions engaged in the macadamia production have been joined by numerous private companies (Gebre & Nyambura-Mwaura, 2018) which has diversified the market space.
Within Embu, several challenges within the macadamia industry have been identified by the Embu County Department of Agriculture (Embu County, 2016). Macadamia factories and companies source the nuts from farmers and middlemen without following a regular scheme. Unlike the coffee industry, there is no legal and regulatory framework for the macadamia production (Embu County, 2016). Knowledge on the local organization structure is not clear and the small-scale farmers seem to la a consistency as of which middlemen to sell their nuts to. This lack of uniformity leads to farmers getting paid low prices for their nuts and sometimes getting cheated in the trade transaction (Sato & Waithaka, 1998). In this context, farmers suffer from a lack of enforcement mechanisms that will put them in a stronger position within the trading process.

Over the years, the development programs designed to improve the macadamia industry in Kenya have failed to take a bottom-up approach during the participation and decision-making process (Gregoratti, 2011). As such, the intended beneficiaries, Kenyan small-scale farmers, have not been empowered or benefited. This was the case of Growing Sustainable Business Initiative (GSB), a program from the United Nations Development Program (UNDP), who offered to develop a project to improve production and marketing for KNC. However, the project proposal was not developed in conjunction with KNC nor the input of small-scale farmers considered. This resulted in the KNC manager regarding proposed as too political and without prospects of real-life implications, and thus refused to implement them (Gregoratti, 2011).

Research Problem

For this research, macadamia farming will be defined using the concept of farming as a social notion that not only includes the physical management techniques, but also good farm management practices which are affected by the socio-cultural factors in which the farmer operates (Vanclay, 1998). Within the context of this project, macadamia farming will encompass not only the process of cultivation, harvest and post-harvest of macadamia trees, but also the notion of why macadamia crops are chosen over others, the marketing and trade of the nuts, and how the finance around this crop is managed. The Kenyan macadamia nut industry is mostly comprised of small-scale farmers who intercrop the macadamia trees with coffee or other food crops (Muthoka et al., 2008), which will be the target population for the research. Small-scale farmers will be identified as any individual growing between 6-100 macadamia trees as stated by Muthoka et al. (2008).

Scientific studies on the topic of macadamia nuts in Kenya has focused on the natural strategies to enhance the breeding and productivity of the trees. Little has been reported on the impact on the livelihood of the first contact point within the macadamia value chain: the small-scale farmers. This project is interested in identifying how the current buying and selling process between macadamia small-scale farmers and factories, buyers or middle-men take place as well as which strategies the small-scale farmers use to optimize their position within this trade. By incorporating a bottom-up approach, the small-scale farmers' reality and decision making practices will be emphasized to identify the challenges and opportunities in order to improve the macadamia farming in Kibugu.

Research Objective

The above research problem leads to the following research objective:
Which challenges, and opportunities arise with farming macadamia in Kibugu, Kenya?
To answer this research objective, the following research questions will guide the project:
1. What is the current status and trends in the farming of macadamia nuts in Kibugu?
2. Which strategies characterize the macadamia trading in Kibugu?

Methods

The research will be based on data collected through five main methods; participant observation, questionnaire, semi-structured interviews, focus group interviews and forest resource assessment. Additionally PRA, GPS-tracking will be used as tools to complement the data collection.

1. Participant observations

When practicing participant observations, the researcher immerses themselves into the culture they are studying only to distance themselves from it again to analyze it. In practice, this means participating in everyday activities throughout the day, and writing down the observations made afterwards (Bernard, 2011). Participant observation makes it possible to collect data that goes beyond the themes proposed by the researcher. In this way, it becomes possible for the researcher to grasp the complexity of the field. Participant observers researchers participate in some aspects of life around them and record the details about it (Bernard, 2011).

Through participant observation we wish to understand the farming and trade mechanisms of macadamia on a local level. We plan to participate in macadamia harvesting activities and if possible trade situations. As participant observers, our goal is to understand the aspects of the labour regarding the harvest, the division of this labour, and the social dynamics within the trading practices. By engaging in everyday life in the village it will also become possible to observe the social order and local market structures.

2. Questionnaires

Questionnaires are a form of structured interviewing, where the flow of the questions, and the possible answers are determined beforehand (Bernard, 2011). Thirty questionnaires targeting small-scale farmers will be distributed at the beginning of our fieldwork. The distribution of the questionnaires will be done through simple systematic sampling. This means that the farmers chosen to fill out our questionnaires will be from every fifth farm in Kibugu with a random starting point. This sampling can provide a representative sample to point out some tendencies for the general population (Bernard, 2011). For our research, the questionnaires will help us understand two parameters; the current state of macadamia farming in Kibugu and how unanimous pricing is between farmers. We will fill out our questionnaires face-to-face by asking the informants one question at a time (Bernard, 2011). We have chosen this method because of a language barrier between the researcher and the informants. With this approach we are able to use an interpreter that will help us shape our questions in ways that are understandable for the informants as well as understand the informal knowledge and know-how that might be relevant in regards to our research topics.

3. Semi-structured interviews

Semi-structured interviews are carried out following a prepared interview guide, which the researcher uses to cover the main themes of interest. The interview setting is formal, where the interviewer takes the lead of the conversation, but at the same time allows space for the informants to expand on their answers. This flexibility allows the informants to include new topics in their responses which often are of importance to the study (Bernard, 2011). In our research we will use semi-structured interviews to understand the farmers' perception on the macadamia status, trends and strategies in Kibugu. We aim to conduct at least ten semi-structured interviews. The target groups of the semi-structured interviews will be farmers, middlemen and personnel from the factories. The farmers will be selected after the completion of our questionnaires.

4. Focus group interview

Focus group interviews are used to discuss a particular topic and to collect the reactions that this topic generates among a particular group of people (Bernard, 2011). It is a qualitative method that allows to understand the rationalities behind people through the recording of their narratives and experiences. During the fieldwork, a focus group interview will be carried out to gain knowledge on how small-scale farmers practice macadamia farming at a domestic level and on their perception on sharing macadamia farming knowledge among one another.

The focus group will consist of ten small-scale farmers identified through the questionnaires and semi-structured interviews. The participants will be divided into two groups of five. Through the discussion in the focus group the social dynamics and sharing of knowledge will be observed. Apart from the participants, a research team member will be the moderator, whose role will be posing the questions and making sure that within the groups all participants have the necessary opportunities to contribute. The location for the focus group interview should be easily accessible and familiar to the small-scale farmers living in Kibugu so they feel comfortable. We plan to carry out the focus group interview at the end of the fieldwork as the participants by then should be used to the researchers presence and hopefully have a relationship of trust with them.

5. Participatory Rural Appraisal

Participatory Rural Appraisal (PRA), later known as Participatory Rapid Assessment, are participatory tools where the informant and researchers asses an aspect of the research. These tools are a fast way to collect data in a local community. They are visual or in other ways creative in their approaches and aim to create dialogue with the involved stakeholders (Bernard, 2011; Mikkelsen, 2005). We plan to use PRA tools in relation to other methods especially focus group discussions or semi-structured interviews. Mikkelsen (2005) highlights that analysis is not just being done for the local people, but through PRA it can also be done by them. PRA tools allows researchers to fill out their knowledge gaps early in the process.

Participatory transects

Participatory transects are done take by drawing up maps or diagrams of the assessed area and achieved through the involvement of participants. Through these the researcher can observe, discuss and take note of the local issues (Mikkelsen, 2005). For our study the aim of participatory transects is to gather information on the cultivation of trees and the changes in the macadamia production. Through participatory transects we can observe and determine knowledge about the farmers' everyday

activities. This method will also allow for farmers with limited English skills to interact and demonstrate their knowledge.

Seasonal calendar

The mapping and drawing of a seasonal calendar indicates relevant periods and factors for the macadamia farming. Besides the cultivation of the macadamia trees, a seasonal calendar will also be helpful to understand the labour required to maintain the macadamia trees throughout the year.

Ranking matrix

A ranking matrix offer researchers insight into people's perceptions and deliver a crucial understanding of the different interests of people. For ranking exercises people are asked to order a group of items which then indicates how strategies are best formulated and actions planned. (Mikkelsen, 2005). We will incorporate ranking exercises to understand the importance of the different crops cultivated by the farmers and the role macadamia nuts play in the farmers' overall farming activities.
Two types of ranking will be employed in our research process: matrix ranking and wealth ranking. The first one is used to gather condensed information on the crops. The ranking matrix will guide us to assess the division between crops and thus the land distribution. This will give us an idea on how macadamia trees are prioritised and which position they take in the farming context. The second aims to assess how big the farmers' income from macadamia nuts is.

6. Forest resource assessment

Forest resource assessment (FRA) is used to monitor trends and changes of forest areas. FRA statistics are useful to see how the forest and agricultural land evolves over time. Often it reflects the impact of decision-making pertaining agricultural policies and reforms (Keenan et al., 2015). One way to carry out FRAs is through the measurement of tree biomass. The biomass of individual trees within a plot is calculated by an allometric equation including the height and diameter of the trees. The biomass of the plot is calculated by adding the individual trees biomasses, and the biomass of the plot is then extrapolated to the rest of the forest (Holopainen et al., 2012). We will use this method to assess the hypothesis that trees of similar size will be roughly about the same age, and thus planted at the same time. With this assessment we will be able to determine whether or not there is a correlation between the world market demand for macadamia nuts and the number of trees in Kibugu.

Methodology

We wish to research the farmer's position regarding macadamia farming and selling by applying multiple methods. We will obtain individual responses through questionnaires and semi-structured interviews, and collective responses from the focus groups. These responses will be compared and contrasted in our analysis. It is important for us to situate our study in Kibugu to obtain the perspectives of small-scale farmers and conduct our study from a bottom-up approach. By combining multiple methods to obtain knowledge, we seek to understand the role of macadamia farming in Kibugu and the influence it has on everyday activities. An example of how combining methods leads to a better understanding of the situation is through assessing the age of the tree by FRA and comparing it with semi-structured interviews and transect walks. By combining multiple methods to respond our questions we can both validate and triangulate our data from different

methods of data collection. In our data matrix (Appendix 1) it is clear which methods we seek to apply to collect data to answer our research questions.

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