Wageningen University – Department of Social Sciences

Technology and Agrarian Development

Innovation, regimes and knowledge dynamics

– In a mango production and marketing project in Mbeere District, Eastern Province, Kenya

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Dedication

To my loving parents and family for the undying support, I love you the most

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II. Executive Summary

The research focuses on innovations, regulatory regimes, knowledge dynamics and the role of the context among four mango farmer groups in Mbeere District, Eastern Province in Kenya. It uses the Innovation systems approach, strategic niche management and the contextualized nature of knowledge and knowledge dynamics as the theoretical framework. The research aimed at understanding the underlying mechanisms and processes leading to the outcomes evidenced in the JOLISAA mango case project. The research was conducted at a micro level inorder to get an insight on the interaction of actors and their knowledges as explained by the innovation systems and network approach. The research took a case study approach as it focused on four heterogenous mango farmer groups spread across Mbeere District. Inorder to get an understanding on the order of events leading to the unfolding of the case, the critical event analysis was used. Data was collected through in depth interviews with stakeholders, focus group discussions, participant observations as well as through secondary data analysis.

Mango is a fruit of economic importance in Kenya as it ranks third after bananas and pineapples on the export returns. There are 32 different mango varieties in Kenya which are classified under two broad categories of indigenous and exotic varieties. Farmers in the study group farm both varieties. However, three of the farmer groups are more inclined towards exotic mango varieties due to their market advantages. The types of varieties to grow were also influenced by the role of organisations such as NGOs which ran mango promotion projects for the exotic varieties. This saw most of the farmers in the areas where the NGOs ran their projects getting more inclined to exotic varieties as they managed to get free certified seedlings. One of the four farmer groups did not have any stakeholder coming to them and so they grow almost entirely the indigenous mango varieties. Since the farmers produce mangoes, they need a market for their produce. The four farmer groups are engaged in mango value addition. The farmers mainly got into mango value addition as a way of addressing the market challenges faced for raw mangoes. Still with mango value addition, the farmers face challenges. The four mango farming groups undergo four similar stages which are: group registration, mango production, mango processing and certification. At each of these stages which the groups undergo, the interplay of knowledge, regulatory regimes, contexts, role of stakeholders could be clearly visualized. Farmers in other JOLISAA innovation cases in Kenya and in other projects elsewhere in the world seemed to undergo the same pattern and face similar challenges.

In conclusion after a close analysis of the case, it emerged that the farmers' groups who had the greatest number of stakeholders cushioning and supporting them progressed further in the innovation chain and are almost achieving their objectives. External stakeholder availability and support was influenced by contextual factors such as electricity and road network which influences accessibility of the farmer groups to the stakeholders. Also as the farmers move along the commercialization chain, they are also moving out of the zones where their knowledge is sufficient into unknowledgeable zones and they tend to become more dependent on external knowledge and external stakeholders.

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Abbreviations

ATDC Agricultural Technology Development Centre

KADI Kamurugu Agricultural Development Initiative

KARI Kenya Agriculture Research Institute

SNM Strategic Niche Management

HCDA Horticulture Crops Development Authority

NGO Non Governmental Organisation

KeBS Kenya Beruae of Standards

JKUAT Jomo Kenya University of Agricultural Technology

GTZ Germany Agency for International Cooperation

JICA Japan International Cooperation Agency

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CHAPTER 1: INTRODUCTION

1.1 Differences on views and perceptions in understanding innovations

Nowadays, developmental projects in Africa just like everywhere else in the world have the word innovation at the centre stage. Innovation occurs when a new thing is integrated into social, technological, institutional and economic processes of a system successfully (Klerkx, Mierlo, & Leeuwis, 2012; Spielman, Ekboir, & Davis, 2009). Innovation is a concept which has received a lot of definitions from different scholars and a lot of people understand it differently. The common parts in the several definitions are that 1) it is a complex process which is non-linear in nature 2) it involves multiple actors and therefore 3) there is interplay of multiple knowledges in the innovation processes (Klerkx et al., 2012).

In particular, the manner in which innovations come about is not easily understood by many. Some say successful innovations are something which cannot be planned due to their complexity and therefore should just be left to happen on their own. They argue that processes of innovation are driven by the needs of people as people are always in a constant mood to want to change ways of doing things thereby triggering innovation and a change in the way of doing things among people in different levels and positions in society. Some people say that innovations come as a result of people undergoing some sort of pressure for example with too hard tasks, or too expensive labor thereby coming up with initiatives to cut costs or make work easier for them thereby re arranging the social structures and initiating the innovation process. Innovation processes are non linear in nature and are a result of social learning processes involving actors from different backgrounds. Research only without social learning processes have been producing results which nobody used. (Devaux et al., 2009; Klerkx et al., 2012).

However, other scholars say even successful innovations can be planned provided there is room for flexibility and adaptive innovation management skills. This group argues that even though innovations can be planned, the innovation process remains a complex process which is always affected by unforeseen and unplanned events and therefore it is important for the innovation network actors to be flexible in continuously interpreting the ever-changing contexts in which they are operating in and re-designing. Therefore, inorder for innovation to be successful, it needs the support of facilitators and techniques such as monitoring and evaluation to enhance the process of system learning (Klerkx, Aarts, & Leeuwis, 2010)

1.2 Innovations Systems and Network approach

It is now widely accepted that the innovation process is not a linear process with technological, scientific knowledge flowing from scientists towards end users. This forms part of the innovation systems approach. The innovation system approach is a set of ideas that entails that innovation mechanisms are not only about production and exchange of knowledge but are influenced by contextual factors such as markets, legislation and infrastructure which have a direct influence on the outcome of the innovation process. Thus, the innovation systems

approach entails that innovations occur in a context; - a system in an interactive and learning process with multiple actors whose capacities collectively are strengthened by depending on each other to innovate (Klerkx & Leeuwis, 2008). The innovation process is always affected by unforeseen and unplanned events and therefore it is important for the innovation network actors to be flexible in continuously re-designing and interpreting the ever-changing contexts in which they are operating in. (Klerkx et al., 2010) say that this needs the support of facilitators and other techniques such as monitoring and evaluation which enhances the process of system learning.

1.3 Strategic Niche Management

One way of using the innovation concepts in Europe is tied around the Strategic Niche Management (SNM). The SNM approach was created specifically to learn the introduction of new promising technology into society (van Eijck & Romijn, 2008). The Strategic Niche Management (SNM) is a framework which acknowledges that innovation is not only about new technologies but also involves institutional change and re-organization of things such as markets and labor. It involves the re-orientation of regulatory frameworks. The SNM framework promotes that after new, promising technology have been developed, they require first to be put on a small scale in a protected area - the niche in order to ensure sustainability. This is because new innovation would still be weak to face the wider environment which is not usually friendly towards the sustenance of new technologies due to features such as the already established institutional frame works, competition from already matured technologies and societal cultures. SNM acknowledges that successful innovation is not only about new technologies but also involves institutional change and re-organizing things such as markets, distribution of benefits and labor. So inorder to establish new technologies, they are first put in as social-technical experiments in a protected area where they grow on their own pace thereby affecting and influencing the already established structures. Through their own influences, the new technologies create their own networks by so doing expanding themselves in a sustainable and gradual process thereby changing institutional regulations and societal perceptions (M. C. J. Caniels & H. A. Romijn, 2008; Kemp, Schot, & Hoogma, 1998; Schot & Geels, 2008).

The SNM is an analytical tool designed to introduce and facilitate the spreading of new viable technologies by means of societal trials (van Eijck & Romijn, 2008). SNM looks at the introduction of new sustainable technologies to test them so that in the long run, the unsustainable technologies are replaced. During establishment of a new idea, there are forces which usually act against the technology. Technologies which we see today fitting in the system, established themselves overtime as they continuosly adjusted to the landscapes. Niche formation is important as it makes identification of main attributes and effects on others to become clear. This makes it easy to understand factors pushing for or drawing back establishment of innovation (Kemp et al., 1998; van Eijck & Romijn, 2008).

The SNM approach has been used on the African settings. An example is in a jatropha project in Tanzania where farming jatropha for use as bio fuel was being introduced. However, challenges

were noted which can relate to the mango case which were acting against the innovation. These include structural policies which were operating within the Ministry of Agriculture in the farming of jatropha and landscape features in Tanzania such poor infrastructural facilities affecting movement of inputs and stakeholders. However, other features were working for the establishment of the niche such as availability of stakeholders and NGOs promoting the farming of jatropha. All these features form part of the broad regime described under the strategic niche management approach (van Eijck & Romijn, 2008).

1.3.1 Regulations in innovations

In Europe, a lot of food and agricultural regulations aim at restoring food and agriculture to being harmless and natural after the outburst of genetically modified foods and unsustainable technologies. Genetically modified crops and animals are being viewed by some as harmful to biodiversity, same as commercial production of crops in a monolithic manner usually for commercial purposes. The advocates for sustainability have seen a lot of farmers in the Western world moving away from producing a single crop to diversification (C. Almekinders, Crane, Harms, Berg, & Fagbemissi, 2012; Klerkx et al., 2010). In The Netherlands, for example, production of commercial pigs in battery cages have received wide range condemnation from various animal groups and individuals despite the high productivity from the cages (Klerkx et al., 2010). Also among consumers themselves, they are increasingly disregarding genetically produced crops and animals due to human health issues, ethical reasons and environmental concerns. These reasons force actors in the food manufacturing and processing industries to opt for organically produced crops inorder to meet the demands of their customers.

The organic agriculture sector is smaller than the more dominant conventional system characterized by usage of biotechnology. The organic sector views practices involving biotechnology to be unsustainable from different perspectives such as technological, social and environmental. However, the farming system which involves biotechnology is the one which suits best to the current regime from different perspectives such as prevailing regulatory framework and policies. As a result new initiatives such as organic farming are faced with a regime which does not really support them. Therefore, the occurrence of frameworks such as SNM in order to first develop these new innovations in protected niches.

The Strategic Niche Management (SNM) approach suggests that sustainable and promising innovations can be brought about through establishing niches which are protected spaces where the new innovation is allowed to establish itself in a contextual environment similar to the one which it will need to adapt to and establish itself on a broader scale. The underlying ideas on the construction of niches are that if these niches are established successfully, they

would expand themselves as on a sustainable pace in the process influencing regime changes socially, contextually and institutionally (Kemp et al., 1998; Schot & Geels, 2008).

In Africa however, written regulations especially in food and agriculture are not as intense as in Europe. However, this does not mean there are no regulations at all. The majority of the African peasant communities often follow unwritten regulations in the form of social norms and values (C. Almekinders et al., 2012). Often they rely on their own interaction networks which are often tied by kinship and religion for survival and development and less on capitalistic tendencies. Most of the farmers get satisfaction from relations and bonds created in the processes of exchanging goods and services without attaching monetary value to it. Lemarchand 1989 describes this as 'ubuntusim' that is being regarded as humanly. This is known as the economy of affection(Lemarchand, 1989; Ngwainmbi, 2000).

However, with the growing issues of globalization even in agriculture and marketing, we see African producers among many elsewhere in the world producing for export including the European market. Therefore, inorder to sell their produce on the European market as well as withstanding competition from other producers they need to meet the European regulations and standards. The majority of the mangoes produced in Kenya for the export market are sent to the Middle East. The European market is not being properly utilized because of quality constraints, regulations as well as having the proper varieties for the European clients in the volumes required (ICRA, 2010; Ministry of Agriculture, 2010).

To understand innovations as well as regulation issues in the African context, l looked at an innovation case in Kenya, East Africa in a mango innovation project where they produce mangoes for both the domestic and export markets. The mango case is one of the Joint Learning in Innovation Systems in African Agriculture (JOLISAA) projects in Kenya. The mango case aimed at understanding mango production, processing and marketing innovation processes among four farmers' groups in Mbeere District. The four farmers' groups were selected to represent over forty farmer groups in Mbeere district. The selected farmers' groups represent the diversity and heterogeneity in terms of gender, group history, administrative boundaries and innovation diversity in Mbeere District.

1.4 Innovation, intervention and knowledge dynamics

Actors in the innovation process are all who are in any way involved in the process at any level. These people possess interests and have their own opinions which are sometimes as a result of political and institutional cultures and therefore actors exercise agency and a degree of power in the innovation process. Understanding the points of meeting of different knowledge disciplines is essential for effective decision making and practical action needed for successful innovation initiatives. Knowledge is transformed and comes into being in relation to the unpredictability of everyday life and the struggles that are part of social life. People judge and analyse if they can trust and adopt expert knowledge through comparing it with their own which they have already tried and tested (Wynne, 1991). Knowledge creation and dissemination

occurs due to the interconnecting and intertwining of various elements. Knowledge and innovation therefore comes as an outcome of interactions and interfaces occurring among different actors. (Long, 2001).

Knowledge is created and used by various different actors in practical ways including in coping with livelihoods and interventions. The success of an innovation involves the incorporation of new ideas and behavioral modes which leads to a process of transformation, in most cases the incorporation of scientific and local knowledge. Local farmers most of the times have best knowledge on what suits their environments agro ecologically as well as in relation to their socio economic statuses and scientists can help on the technical issues (C. J. M. Almekinders, 2011).

Different actors with different knowledge backgrounds are participating in the mango case including people who are experts in their disciplines. In most cases, experts often operate on a rule-based rationality mode of thinking which often acts as a drawback to the accomplishment of desirable results due to the over reliance on rationality which is insufficient as most of the times it is faced by a challenge which it cannot solve. Taking expert knowledge to extremes have been blamed for making scholarly disciplines to become less sensitive to contexts, intuitions and people's own experiences. Therefore because of the challenges faced by scientific knowledge on its own, nowadays there is growing appreciation in combining scientific with non scientific knowledge for sustainable solutions to the problems of today's world. The points of convergence and interactions of local people and scientists are central to the production of more adopted, sustainable solutions which also counters what modern technology on its own and economic development tried to do (C. Almekinders et al., 2012).

1.5 Research problem Statement

The research aims to understand the underlying mechanisms and processes leading to the outcomes currently being evidenced and achieved in the project as the results of the project intervention in the specific context. The mango production and processing project is classified by JOLISAA as an innovation case. Innovation success depends upon the outcome of the interactions occurring amongst multiple actors and their knowledges within the context. Innovation issues have sparked a lot of debate (Klerkx et al., 2010) with some arguing that the most successful ones are those which initiate on their own while others argue that it is something that can be planned but requires adaptive innovation management skills entailing a degree of flexibility during the course of the innovation project. These are the two extreme positions of innovations and a lot more come between these two which maybe are more realistic ways of looking at innovations since they encorporate both perspectives. Innovation success entails encorporating technological, social, economic and institutional aspects of a system (Klerkx et al., 2012). However, the sustainability of innovations is a complex process since newly developed innovations need to survive an established broad socio-technical regime(M. C. Caniels & H. A. Romijn, 2008).

It is on the micro level that l intended to get a detailed insight on the interaction of actors, regimes and knowledges in the mango project using the innovation system and network approach and the strategic niche management approach as theoretical framework. The research took place in Mbeere District, Eastern Kenya from August to December 2012. I described the process and found a clue to understand why the process develops in the way it does.

1.5.1 Main research question

How are the project's outcomes explained by the interplay amongst multiple actors with different goals and knowledge backgrounds and influenced by the context?

1.5.2 Specific research questions

- How do local and scientific knowledge interact and what are the effects of this interaction of different know ledges?
- What are the mechanisms and underlying processes involved?
- How are the practices of the different actors influenced by the prevailing regulatory regimes?

1.6 Research Methodology

1.6.1 Case study approach and type of data to be collected

In this study, the description of process with practices and events helped to explore explanation for the interactions and outcomes of these interactions of different actors involved in the mango case. This departs from the notion that different actors have different contexts which explains their different actions, practices as well as perceptions.

The case study approach was used in this research to analyse each of the four mango cases. Each mango farmer group was taken to be a case. The case study approach looks at a specific case with various attributes such as uniqueness and complexity in nature. The case study is used as a research strategy to analyze a case at hand in depth taking everything into consideration at the same time acknowledging that some of the processes witnessed in a specific context may be as a result of processes happening at a higher context such as national and global policies. However, the case study approach have been looked down upon by many because of its poor external validity (Verschuren, 2003).

1.6.2 Critical event analysis, causal process tracing and critical realism

In this study I described the process and outcome of the four mango cases. The outcome takes an explanatory focus and gives an explanation on how things come into being. I broke it into two parts;-the first and second order explanation. The first order explanation entails a thorough and detailed narrative and description of the process; how it started and how it unfolded,

stakeholders involved and what happened over time. The second order seeks for explanations and tests programme theories. In this research, it seeks to understand how the complex innovation processes function; that is how and why they may succeed or why they may fail in the given settings and contexts.

Program theories are conceptualized as mechanisms. The mango case falls under program theories because it is a planned innovation case. Mechanisms occur in a context which refers to existing institutional, organizational and social conditions that determine the innovation practices to be adopted and this later lead to observed outcomes (Pawson, Greenhalgh, Harvey, & Walshe, 2005; Pawson & Tilley, 1997). In the mango case, l looked at the prevailing regulatory regimes at different levels influencing farmers' practices and the direction of the innovation path. This was through following the events that occurred in the pathway of each of the four cases and understanding reasons behind the occurrence of the main events. The occurrence of these mechanisms is influenced by the regimes.

Innovations in project mechanisms also have forces acting upon them which are often unforeseen by the project planners. These mechanisms sometimes occur naturally and are the reason behind innovations occurring even without planning them at first. The causal explanation allows the unfolding of intervention to be non-linear and can operate in any form even in reverse (Pawson & Tilley, 1997).

Interventions have a long route which they take which begins from the point they are formulated through to implementation and the visualization or witnessing of results. Different cumulative relationships, strategies and links are formed from time to time which determines the success of the intervention. Therefore the causal explanation seeks to explore the implementation chain of the project in retrospect, examining and taking note of flows, blockages as well as areas and points sparking debate and misunderstandings in the Mango project among different stakeholders involved. This will be done through the historical/event analysis. Events occur due to the result of change over time therefore collecting event history data can be a way for studying and understanding processes. Event history relates to records of when events occurred and therefore collecting data on dates as well as possible explanatory variables in relation to the event. This data can be gathered through interviews and document analysis (Pawson et al., 2005).

1.7 Data collection

Data was collected using various methods which include in-depth interviews with relevant project stake holders at different levels which were randomly but careful selected inorder to get insight on the knowledge dynamics at different levels. Data was also generated through the method of participant observations inorder to understand practices and knowledge that stakeholder use in the innovation process. Focus group discussions were also conducted during field visits as well as during a workshop conducted with several stakeholders. I also collected

some data through document analysis inorder to understand how events have been unfolding since the inception of the innovation process.

CHAPTER 2: MANGOES AND FARMING SYSTEMS IN KENYA

2.1: Introduction

Over 80% of the Kenyan population lives in rural areas. Approximately seventy five percent of the rural population is involved in agriculture. The agriculture sector is of significant importance to Kenya and is the backbone of the economy. Agriculture contributes 26% of the GDP. It employs above 80% of the labor force, earns the country foreign currency and it provides raw materials for manufacturing industries. Small holder farmers dominate the agriculture sector and they contribute 75% of the total agricultural output (Ministry of Agriculture, 2010).

The government of Kenya acknowledges the importance of agriculture as one of its economic pillars. In the government document which envisions Kenya by year 2030, agriculture is to be more commercially oriented, more innovative, promoting value addition of crops and animal products before they reach the market. The aim is to achieve the above mentioned through government initiatives such as transformation of key institutions as well as increasing market opportunities for small holder farmers (Government of Kenya, 2010).

The horticulture sector comprises fruits, vegetables and flowers. Mango is a horticultural crop. The horticulture sector contributes approximately 13% of the GDP. Horticulture (through fruits) accounts second after tea in terms of earning Kenya foreign currency. According to a report published by the Ministry of Agriculture, more than 65% of Kenya's total exports are attributed to Agriculture (Ministry of Agriculture, 2010).

2.2 Mango farming in Kenya

Mangoes are not indigenous to Kenya. The mango fruit was brought during the 14th century by traders of slaves and ivory from India and Pakistan. The fruit was introduced mainly through the Coastal region the entry points of the traders and later diffused to other parts of the country (Griesbach, 2003; Njuguna, Wepukhulu, & Wanjala, 2006). Mango growing in Kenya is concentrated in the Coast, Eastern and most recently Western and Central regions which are entering into commercial production through cultivation of improved varieties (ICRA, 2010; IDM, 2010). Mangoes are classified 3rd as a fruit of economic importance to Kenya after bananas and pineapples. Mangoes are of great economic importance to Kenya as they contribute to foreign currency and employment creation. The mango is a tropical fruit which does well in drier parts of Kenya where most food security crops do not perform well and so it upholds the livelihood of the rural farmers found in such areas. The mango industry also provides business opportunities to small scale farmers found in rural communities thereby raising their living standards (Ministry of Agriculture, 2010; Njuguna et al., 2006)

There are a total of 32 different mango varieties across Kenya which can be classified under two broad categories which are fibrous (indigenous) and non fibrous (improved/exotic) varieties (Griesbach, 2003; IDM, 2010).

The fibrous varieties originated from India and they gained entry into Kenya during the slave trade era. These are now referred to as the indigenous/traditional varieties. Majority of the non fibrous varieties being grown in Kenya with the exception of Apple, Ngowe and Boribo are a result of continuos agricultural research in Kenya where crossing of varieties was done considering market demands and agronomic properties. Improved varieties usually result using the process of grafting and therefore they are sometimes referred to as grafted mango(Griesbach, 2003; IDM, 2010).

A pilot programme for the growing of improved varieties in Kenya was initiated through a GTZ programme which ran in the late 70s until early 80s. The project was in prison farms and developed through KARI research stations. Through this project, a lot of varieties from USA (Florida) were introduced such as Kent and Van Dyke (Griesbach, 2003; Njuguna et al., 2006).

Due to various agro ecological conditions and market suitability the main commercial varieties that have been widely adopted in Kenya are Apple, Ngowe, Tommy, Kent and Van Dyke (Griesbach, 2003; IDM, 2010).The majority of mango production is from small holder farmers contributing 80% of total production (ICRA, 2010; KARI, 2011; Ministry of Agriculture, 2010). Local varieties are grown naturally that is without much crop husbandry. The indigenous varieties are not suitable for export due to their high fibre content. Therefore the commercial production of mangoes is built upon continuos development of improved varieties (FAO, 2008).

2.2. Mango varieties in Kenya

There are different mango varieties. The diversity allows the fruit to be used for different purposes and markets basing on being manipulated into different products or being sold as raw. The multiplicity of products leads to several market entry points which are important for a livelihood source, employment creation and foreign currency. Both the indigenous and exotic varieties of mango are grown in the Eastern province while 70% of the mangoes produced in the Coastal region are indigenous. In the Coastal region, two mango harvesting seasons are experienced while only one in the eastern province and other mango growing regions of the country. Mango production is mainly done through rain fed agriculture (FAO, 2008).

The production potential of mangoes has not been fully realized in Kenya. This is because of several reasons ranging from lack of quality planting material in sufficient quantities, poor production management practices and poor marketing infrastructure. Another important reason is the lack of varieties suiting the different agro ecological zones in Kenya (Njuguna et al., 2006).

Different varieties suit different agro ecological conditions. Generally, mangoes grow best in warm tropical climates with optimum temperatures around 26ºC. Altitude differs from variety to variety with varieties such as Apple doing best at altitudes lower than 800m while others such as Tommy does best in high altitudes of up to 1800m. At altitudes above 1900m, mangoes tend to acquire a bitter taste and become more susceptible to pests and diseases.

The minimum amount of annual rainfall for optimum production is 500mm. the range between 500- 1000 is necessary for sustaining good fruit production. In Kenya mangoes can be cultivated in any region provided the suitable variety for the area has been identified (Njuguna et al., 2006).Generally mango production in Kenya is based on seven varieties which are Apple, Ngowe, Tommy Altkins, Van Dyke, Kent , Haden and Sensation. The other varieties are brought about due to crossing of these main varieties Apple and Ngowe varieties do well in low lying areas with an altitude below 500m. The other five varieties are originally from Florida. The Florida varieties can also perform under both low and medium altitude areas of up to 1600m. However, Florida varieties have several shortcomings. The major issue is their susceptibility to pests and diseases (Njuguna et al., 2006).

2.3 Description of the main mango varieties grown in Kenya

2.3.1 Apple

It originated from the coastline. This variety produces fruits of medium-large size which are almost round shaped. When the fruits are ripe, they have a deep yellow/orange color. The fruits have a smooth skin and have a juicy flesh which is fibre free. The harvesting period depends on location within Kenya but it usually falls between December- March. The variety is medium yielding.

Its main advantages are that it is matures early and produces fruits of excellent quality. It is fibreless and the size of the seed is small.

The disadvantages are that the variety cannot be grown across all altitudes since it performs well in lower altitudes. Apple is prone to attacks by the mango weevil and diseases such as powdery mildew. The variety also can skip bearing seasons (Griesbach, 2003; Njuguna et al., 2006).

2.3.2 Kent

The Kent variety originated from Miami, Florida as far back as 1944. Kent is almost the same as another variety called Keitt. The only difference is that Kent matures earlier than Keitt. The Kent variety is fibreless and possesses a rich flavor. It is high yielding and matures late after all the other varieties so it is popular among farmers inorder to extend income period after harvesting the other varieties. The variety has a good shipping ability and can survive long periods on the sea.

However, the ripening stage is difficult to determine by looking externally since it remains green even when ripe. This makes it difficult to market after reaching the export destinations. Also the variety is susceptible to storage diseases (Griesbach, 2003).

2.3.4 Ngowe

Ngowe originated from Zanzibar. The trees are usually small and they form a round shape. Ngowe is a medium yielding variety and bear fruit in alternating seasons.

The main advantages are that it bears fruits of excellent quality. Also the size of the tree is small making management easier. The fruits can be shipped with ease. The other advantage is that the seed of the variety is poly embryonic and so the seed can be used for propagation.

However, the Ngowe variety is susceptible to diseases especially the powdery mildew (Griesbach, 2003).

2.3.5 Vandyke

The variety originated from Florida. Van dyke is a medium yielding variety and it bears fruit on almost every season. It bears fruit of excellent outlook. The variety is resistant to diseases such as anthracnose and can be shipped well.

However, the fruits are small in size and this makes marketing difficult. Vandyke is also suffers from internal breakdown (Griesbach, 2003; Litz, 2009).

2.3.6 Haden

This variety originated from Florida. Haden has a good quality seed which can be used as parental stock also for crossing with other varieties. It produces medium to large sized fruit and it is an average yielding variety

The advantages of the fruit are that it possesses an attractive appearance making it easy to market. The quality of the fruit is excellent and so the variety is used for commercial purposes. Haden can be shipped with ease.

The disadvantages are that the variety is prone to diseases especially anthracnose and has a weak resistance to powdery mildew. Therefore Haden is expensive to produce because it requires sufficient inputs to ensure disease free harvests. Haden alternates bearing (Griesbach, 2003; Litz, 2009).

2.3.7 Tommy Altkins

Tommy Altkins originated from Fort Lauderdale in Florida. The variety is usually cultivated for commercial purposes. Tommy Altkins is averagely juicy and the fibre content is moderate.

The advantages of this variety are that it is diseases resistant and production is consistent. Tommy Altkins has a long shelf life and therefore it is excellent for shipping.

The main disadvantages are that the fibre content is above average. Also Tommy Altkins is prone to developing a jelly seed (Griesbach, 2003)

2.3.8 Sensation

The Sensation variety originated from Miami in Florida. Sensation is a late maturing variety. In Kenya the harvest period for Sensation is between February and April.

The advantages are that it a fibreless, firm, sweet and juicy therefore it is of excellent quality. Sensation is a high yielding variety.

The main disadvantages are that bearing alternates and ripening is not even. Sensation is also prone to diseases especially anthracnose (Griesbach, 2003).

2.4 Pests and Diseases

Mango growing regions in Kenya spread throughout the suitable agro ecological zones across the country. Mango yields are mainly affected by pests with the main problematic pest being the mango weevil (Mwangi, 1983). However, the incidence of pests and diseases can easily be reduced through implementing good production practices such as proper selection of orchard sites, selection of suitable mango variety for the area, good irrigation timing and proper adherence to spraying programmes. However, even with adherence to the above mentioned aspects, it is always necessary to keep checking for signs of incidence of diseases and pests so that control mechanisms can be implemented early. Also to avoid chemical resistance, it is always important to rotate the type of pesticides used (Griesbach, 2003).

2.5 Mango marketing

The mango market for Kenyan mangoes is divided into two: the domestic and export market. Approximately 98% of the mangoes produced are consumed on the domestic market and between 1-2% exported. Most of the mangoes that are produced are consumed around the production areas while the other percentage is sold to the urban customers. The most dominant mango market types are the modern and traditional system markets. The modern market chain is when the mangoes are channeled to the final consumers through supermarkets and wholesalers. The traditional marketing system is where mangoes are sold on open air market stalls. Street mango vendors are also common who sell their mangoes to low and medium income consumers and they fall under the traditional marketing system category (ICRA, 2010; Tschirley, Ayieko, Hichaambwa, Goeb, & Loescher, 2010).

The majority of the mangoes therefore enter the market through middlemen. The other buyers are local traders for local markets and local consumers (FAO, 2008). Middlemen are the main mango buyers and usually act as agents for exporters and processing companies. Most processors and exporters do not purchase mangoes directly from farmers. Usually, farmers market their mangoes on individual basis with exceptions on group marketing. The main buyers for the mangoes are middle men usually linked to big markets such as mango processing companies, exporters and big retail shops. Brokers are usually the ones who come and buy from the farmers. Farmers are however unhappy with brokers because they are unreliable and

tend to be take advantage of the farmers' market woes. However the brokers say that the issue with the mangoes is that they are of a poor quality as they are affected by pests and diseases, poor harvesting and post harvest techniques. This coupled with low production levels make the brokers to move from one farm to another in search of mangoes. This increases the transport costs coupled by the poor roads. This according to the brokers makes them to fail to offer the prices that the farmers may require (ICRA, 2010). Exporters and processors are even stricter on quality and standards than middle men and so a very small proportion of farmers produce mangoes directly for exporters (FAO, 2008).

The export market is only a small percentage of the total national production mainly due to failure to meet the required standards. Kenya competes with other mango producing countries on the export market such as Mexico, India, Pakistan and South Africa(FAO, 2008; Griesbach, 2003). The exports are mainly directed towards the Middle East and the United Kingdom. Even though Kenya has an access to the lucrative European mango market, the opportunity is not fully utilized because of the prevalence of pests and diseases which makes it difficult for the Kenya mangoes to quality. Recently majority of the exports have been towards the Arab world because of strict European export standards (Ministry of Agriculture, 2010). The market chains for both the domestic and export market are summarized in the Figure 1 below:

Figure 1: Market chains for mangoes in Kenya

Farmer ⟶ Local Traders ⟶ Rural Consumers

Farmer ⟶ Middlemen ⟶ Wholesale & Retail Traders ⟶ Consumers

Farmer ⟶ Middlemen ⟶ Mango Pulp/ Juice Processors ⟶ Consumers

Farmer ⟶ Middlemen ⟶ Exporters ⟶ Export market

Source: IDM report, 2010

The Middle East market prefers three varieties which are Apple, Tommy and Haden sent by sea. Lately there has been an increase in sea freight charges due to pirates on the Indian Ocean attracting high fees from exporters. This makes the mangoes to be sold at a high price in destination countries, making them to be uncompetitive. The European market prefers varieties

of the USA origin which however are difficult to transport by sea because they get ripe quickly. Competing imports on the Middle East markets are from Pakistan and India (ICRA, 2010).

Inorder for the Kenya markets to remain competitive towards gaining foreign market access, it is important to sustain a reliable mango supply of good quality fruits which continuosly meet standards which are always being improved and upgraded. The challenge comes when there is need to maintain mango quality in the face of challenges especially pests and diseases (ICRA, 2010)

2.6 Background information on Mbeere District

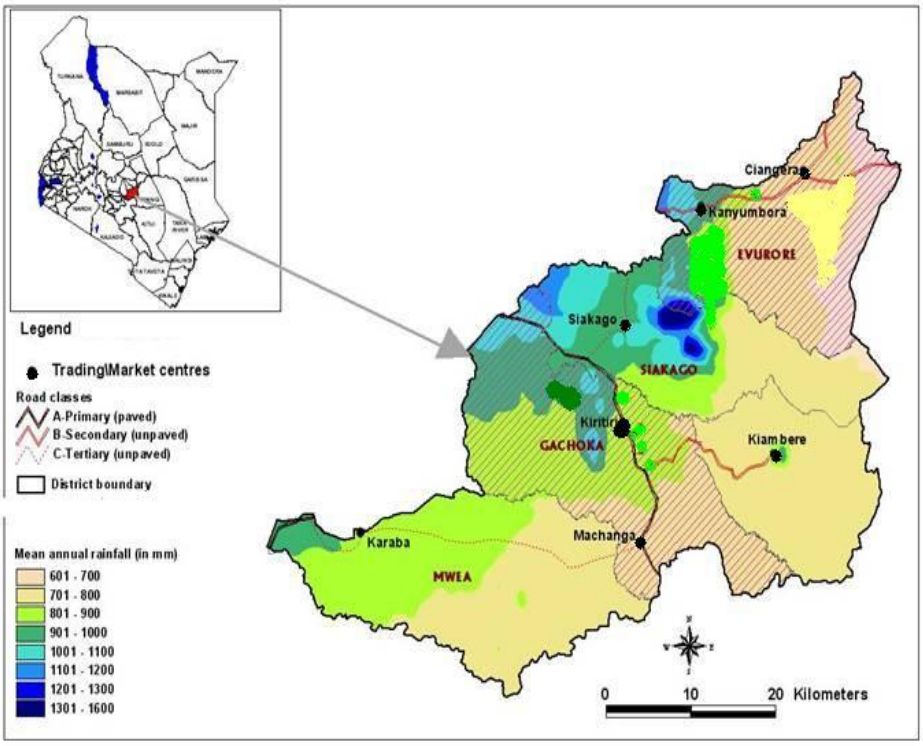
The study area Mbeere District is located in Eastern Province of Kenya (ref to map, Figure 2). Eastern province has over 92,000 farmers who are into mango farming. The province has the greatest mango tree population in Kenya with over three million trees covering a total area of 42,000 hectares. The mango sector in Eastern province is growing continuosly. Mangoes contribute significantly towards the household incomes of people in this area which is often hit by food insecurities. An increase in household incomes will go a long way in alleviating food insecurity through a developed mango sector as mangoes can thrive on the amounts of rainfall received in this area (IDM, 2010).

Mbeere lies on latitudes 0º 20', 0º50' South and longitude 37º 16' and 37º 56' east. Mbeere occupies an area stretching 2. 092km² with a population of approx 200, 000 people (ICRA, 2010).

Mbeere has a biannual rainfall pattern with rainfall ranging between 600- 1200mm per year whilst most areas of the district receive an average of 550mm of rainfall per year. Mbeere District is classified under the Arid and Semi Arid lands (ASAL). The terrain in Mbeere District is characterized by steep slopes due to the proximity and location of the area from Mt Kenya. The terrain and the soil types found in this area make it difficult to move around in the district. The roads become slippery and difficult to bypass as they get filled by surface runoff water and cause erosion and gully formation. However, this problem can be solved through infrastructural development and improving on contextual features in creating reliable all-weather roads (ICRA, 2010; Mugwe, O'Neill, Gachanja, Muriuki, & Mwangi, 1999).

The district is divided into several agro ecological zones based on features such as altitude, soil type and rainfall as summarized in Table 1. The higher attitude areas are mainly for mangoes and cotton growing whilst tobacco and livestock areas are the low rainfall areas (ICRA, 2010).

Figure 2: Map showing Mbeere District



Source: Mbeere District Agricultural Office

2.6.1 Farming systems in Mbeere District

The farming system in Mbeere is mainly the traditional farming system including both livestock and crops. There is an interdependence between the crops and livestock as they depend on each other for establishment and food respectively (Gachohi, Kitala, Ngumi, & Skilton, 2011; ILRI, 2004)

Livestock includes mainly indigenous cattle, sheep, goats and poultry. Food crops grown in the region include cereal crops such as maize, sorghum, millet as well as legumes like beans, cowpeas, green grams and pigeon peas.

Fruit trees are part of the farming system in Mbeere District. The most famous tree in Mbeere is the mango which is usually grown for consumption (food security). Currently, the area under mango in Mbeere district is around 1500 ha with an average yield of 4 tons/ha. The potential area for mango production is approximately 5,000 ha with a yield of 20 tons/ha (ICRA, 2010). Mangoes in Mbeere follow a single harvest period per year. The commonly grown in Mbeere are the indigenous varieties which are usually intercropped in fields among other crops. However the main disadvantages of these indigenous varieties especially with intercropping is that the trees grow into large canopies which overshadow other crops they would have been intercropped with. The fruits from the indigenous varieties generally have a big seed and are fibrous so their marketability is low. These main problems associated with indigenous varieties can easily be addressed through adopting improved varieties which produces fruit of a better quality. Also the height of improved varieties leaves space for the growing of other crops (Mugwe et al., 1999).

Mbeere District generally possesses a great production potential but the major challenge is unreliable rainfall distribution over the cropping periods. The unreliable rainfall in mango farming becomes a major issue especially when growing improved mango varieties. Rain fed irrigation still remains the most important production system in the district. The water issue is being addressed through setting up of irrigation schemes, water harvesting structures and adoption of drought tolerant crops. The area is classified under The Arid and Semi Arid Lands in Kenya. Therefore it is sometimes necessary to have irrigation water or other forms for water management especially when establishing mango seedlings (District Agriculture Office, 2012; ICRA, 2010).

Table 1: Agro-Ecological Zones For Mbeere District

Agro-ecological zone	LOCATION	Altitude	Temp °C	Rainfall (mm/yr)	Size/ Area (Km^2)	%
UM3 marginal coffee zone	South of Siakago market towards Maathai	1280 - 1460	20.7 - 19.6	1000-1250	20	1
UM4 Sunflower/ maize zone	Upper parts of Siakago and Gachoka divisions	1280 - 1400	20.7 - 20.0	100-1100	51	2.4
LM3 Cotton zone	Upper parts of Gachoka (Mbeti) & Siakago (Riandu) divisions	1070 - 1280	22.0 - 20.7	900-1000	225	10.6
LM4 Marginal cotton zone	Upper parts of Siakago, Kiritiri, & Evurore location	980 - 1280	22.5 - 21.0	280-900	339	16
LM5 – Lower Midland Livestock/millet zone	Covers Evurori & Ndurumori locations of Evurori division and Mutitu location of Siakago & almost the whole of Mwea division.	830 - 130	23.5 - 21.7	700-900	1,247	60
L5 Lowland Livestock/Zone	Kiambere location of Gachoka and Ndurumori location of Evurori division	760 - 830	23.9 - 23.5	640-700	215	10

Source: District Agricultural Office (DAO) Mbeere

2.6.2 Mango varieties in Mbeere District

Both the indigenous and improved mango varieties are grown in Mbeere. However due to many project initiatives, more and more farmers in Mbeere District are adopting the improved varieties. Approximately 30% of mangoes in this region are indigenous with 70% of the varieties grown being improved varieties. For many years, the traditional mango varieties were the popularly grown. These varieties have a big seed and are fibrous. Their shortcomings are easily addressed by improved varieties. However, improved varieties require good crop husbandry practices which therefore appear costly to most of the farmers in Mbeere as they fail to cope with the fertilizer applications, pruning and spraying regimes (ICRA, 2010; Mugwe et al., 1999)

2.6.3 Pests and Diseases affecting mango production in Mbeere District

There are several pests and diseases affecting mango production in Kenya, Mbeere District included. The most common pests are mango fruit fly and the mango seed weevil. The most common diseases are the powdery mildew and anthracnose (Griesbach, 2003; ICRA, 2010).

2.6.3.1 Mango fruit fly

Fruit flies attack mangoes at the ripening stage. The mango fruit flies are of the species *Ceratitis.* Three different types of the fruit fly which are common in Kenya are the *Ceratitis* Osa, *Ceratitis capitata and Ceratitis Cosyra.* The fruit flies are dangerous and have the ability to reduce the average yield of mangoes by half.

The female fruit fly lays eggs on the skin of mango fruit. The eggs hatch into maggots which penetrate the skin of the mango. The flies cause damage as they attack the mango fruit from inside. This causes the fruit to adopt the color of a ripening fruit immaturely.

Different varieties are attacked by the flies differently. Other varieties are more prone to attack than others. Generally indigenous varieties are more resistant to attacks than the improved varieties (Griesbach, 2003).

The main method of controlling this pest is through use of chemicals. However, the pests can be prevented through maintaining orchard hygiene and removing non productive trees including of other fruits which provides flies with harboring places.

2.6.3.2 Mango seed weevil

The mango weevil is found in all mango producing regions of the world (Woodruff & Fasulo, 2007). In Kenya, it is the pest which is also found in all mango producing areas. The weevil spreads mainly through the seeds of infected fruits. The female weevil lays eggs on fruits. The eggs hatch into larvae which enters the fruit into the seed where they continue developing into adult weevils. It grows and develops itself inside the seed, so people can easily carry it

unknowingly to wherever places they go with mangoes. In the event that the weevil comes out of the seed, it leaves dark patches on the skin of the fruit which causes rotting.

The mango weevil is not a disturbing pest on the domestic market since the fruit appears normal even after infection. The weevil does not cause any visible sign of infection externally. The pest affects the export market as the countries buying the mangoes are strict towards pests and diseases so they undertake serious quarantine measures on imports. The pest exerts quality control issues and it is of economic importance (Thomas, Kannan, Degwekar, & Ramamurthy, 1995).

Weevils usually find a home on dead plant materials and grass during chilly weather or when mangoes are out of season. Therefore farm hygiene is one of the best ways to control the weevil as this destroys the harboring places of the weevils. It is also important to apply chemicals on trunks and branches on the trees during the flowering stage to prevent the female weevils from attacking. The weevil can also be controlled on the fruits through chemicals when treating the fruits for other pests and diseases such as powdery mildew and anthracnose (Griesbach, 2003).

2.6.4 Mango marketing in Mbeere District

Generally mango prices have been going up over the past years and this explains why a lot of farmers are increasing their area under mango. Mangoes are sold either as fresh or as juice in most rural and urban places in Kenya. Mango prices depend on variety with improved varieties fetching more than local varieties. However, the prices also vary among the improved varieties. The Kent variety gets highest price followed by apple, then Tommy and Ngowe (FAO, 2008).

Over 75% of the mangoes in Mbeere District come from smallholder farmers. 60% of the mangoes in Mbeere are consumed within the district and some within the 60% are wasted. Majority of the 40% is channeled towards the fresh fruit market or towards national processors with only less than 2% being exported through brokers.

Small holder farmers usually sell their produce at their farm gates at low prices (Markelova, Meinzen-Dick, Hellin, & Dohrn, 2009).

In the event of taking mangoes to the market on their own, farmers usually use the matatus (small minibuses used for public transport) for transportation. This lowers the product quality and makes the fruits to fetch poor prices on the market. The issue of poor prices is worsened during the mango season when the market will be flooded due to product oversupply (ICRA, 2010).

2.6.5 Challenges faced by mango farmers in Mbeere District

The mango farmers in this region are faced with a lot of challenges which can be classified into two broad categories as production and marketing challenges. Production challenges include the incidence of pests and diseases, poor planting materials, low yields due to draught since mango production in this area is mainly rain fed.

Marketing challenges include unstable market prices, indirect market access as farmers go through brokers and lack of infrastructural facilities such as reliable all weather roads for easy market access.

CHAPTER 3 :REGIME ENCOUNTERS

3.1 Introduction

The mango case examines four mango farmer groups in Mbeere District. The four groups were formed at different times ranging from 1991 to 2009. The groups were all formed through farmers' own initiatives. The aim of forming the groups was to address contextual issues and circumstances. These issues include collective marketing of crops, sharing farming chores and bringing water to homesteads. Despite the groups having different reasons for their formation, as time went by, they now have the commonality of mango production and processing since they all have mangoes. With mango production and processing, comes the issue of market accessibility. Mango processing adds value and extend the shelf life of the mango. Processing overcome quality constraints, issues of poor infrastructure and make the mangoes which are not marketable as determined by the market of raw mangoes get a way into the market. Overally, mango processing helps in overcoming regulatory constraints especially those set by the fresh mango and export market. The mangoes that cannot be exported and those not absorbed by the domestic fresh mango market are processed. The groups therefore undergo similar stages in their quest to have their mangoes and mango products on the commercial market.

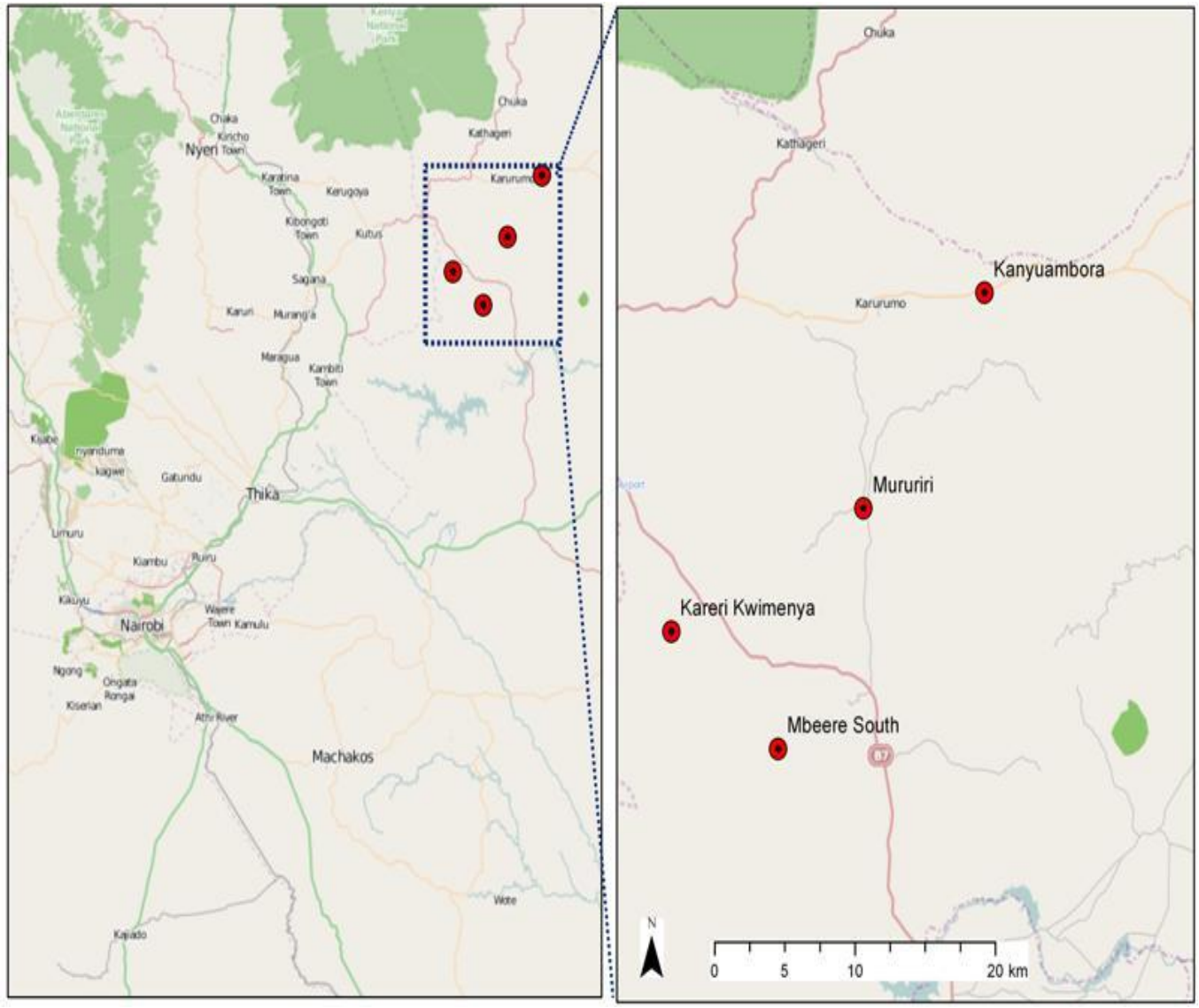
A certain trend can be noticed through a close analysis of the group history; where they have come from and their current position along the innovation chain. They face several challenges on the innovation path. Therefore when faced with these situations, they tend to depend on the external knowledge and support they are getting from stakeholders who jump on board. However, stakeholder availability is not determined by farmers. Usually, the stakeholders coming to their rescue are mainly NGOs who will be running their own projects with their own agendas. The stakeholder who is somehow available nearby especially for basic agricultural knowledge support is the government. The government is an important shaper of regimes and contexts. However, in most cases the government local offices failed to bail farmers out of their situations as they required intervention at higher offices or from a different responsible ministry for example in the case of financial assistance, poor roads and electricity availability. The government however in this case through its Ministry of Agriculture offices provides information support and in most cases link farmer groups to other stakeholders and projects which may provide specific assistance.

I will break the innovation path and the commercialization quest of the four cases into four main stages and explain the interactions and challenges that occur at each stage in relation to the context, regulatory regimes and knowledge dynamics. The four stages for the four cases are explained under group formation, mango production and management, mango processing and certification. I will explain these stages in relation to each farmer group (case) in this sequence:

- Kanyuambora Mango Growers Self help group
- Mururiri Self Help Group
- Kareri Kwimenya
- Mbeere South Rural Empowerment Initiative

The position of the farmer groups in relation to Nairobi and the major roads surrounding them are illustrated in the map (Figure 3) below:

Figure 3: Map showing position farmer groups positions



3. 1 Kanyuambora Mango Growers Self Help Group

3.1.1 Group formation

The group came together as early as 1991 through farmers' own initiatives as influenced by their contexts. The aim of coming together was for collective marketing of mangoes. The farmers wanted to surpass brokers who were coming to buy their mangoes at very low prices and so the farmers formed a group for collective marketing of their mangoes. After forming the group, the farmers started marketing their mangoes together.

Kamurugu Agricultural Development Initiatives (KADI) was the first external stakeholder to work with the group. KADI is a catholic based local NGO. KADI introduced improved mango varieties to the group between 1991 and 1992. KADI supported the farmers with improved mango varieties and worked with the Ministry of Agriculture during that time to give the farmers knowledge on production of these varieties. KADI left after three years and the farmers continued marketing together their mangoes during the mango season. The group was not very active outside the mango periods.

In 2007, the group decided to become more active inorder to attract more stakeholders. However, during 2007, the group could not do much because it was a year of elections. The group had a membership of thirty-six (36) during this time. However, as of November 2012, the group membership had reduced to twenty-three (23) active members consisting of six (6) women and seventeen (17) men. Some members became inactive when issues such as subscriptions were introduced after the group had been registered. The group members said that sometimes contributions can be as high as 1000/- (approx. 8, 5 euro) for example when the group was raising money for three phase electricity. This is generally a lot of money for most of the group members to part ways with.

In 2008, the farmers approached the Ministry of Agriculture because they were experiencing a lot of losses due to brokers who could not take all the fresh mangoes. The farmers wanted the Ministry of Agriculture to assist with information on how to prevent fresh mango post harvest losses. During that time, the government was running a project called the Arid Lands project which provided agricultural mechanization/equipment support to farmer groups in dry parts of the country to use in agricultural processing. Inorder to gain recognition to participate in the project, Ministry of Agriculture (Agricultural Technology Development Centre (ATDC) encouraged the group to get registered with the Department of Social Services.

The farmers already had a group but they did not have knowledge on group registration. The government, through the Ministry of Gender provided farmers with the knowledge on the importance of group registration and facilitated them along the process. With the help of the facilitation from Ministries of Agriculture and Gender the farmers came up with the requirements of registration which are group by laws, a discrete leadership structure and a bank account.

Ministry of Gender continued with giving the group knowledge on group dynamics. The group already was coordinating their operations through a leadership structure but this one now was more discrete with written down rules. However, it was not difficult for them to follow the rules because their village leadership structure was almost familiar so it was easier to adapt. Still they were careful with the allocation of positions with the demanding tasks been given to elderly men also taking into account literacy and age. Literacy was an important factor because the farmers wanted someone who was flexible with attending meetings anywhere, travelling anytime of the day as well as reading and understanding documents plus signing for their group bank account. Therefore, the most demanding tasks were mainly directed to literate elderly man whom the group could trust to represent them in meetings. Another reason why the most demanding tasks went to elderly man was because men are in charge of homes and can travel anytime of the day. Women are mostly tied down with household and family chores.

During group registration and formalization process as dictated by the regime, the farmers' also got knowledge on forming subgroups. Subgroups are small groups made within the main group responsible for spearheading specific group tasks such as processing and marketing group products. In 2008, the Kanyuambora group formed subgroups within their group with the help of Ministry of Gender. This was to ease group activities. However, an NGO, ACDI-VOCA facilitated the group on the same starting from 2010 and complimented Ministry of Gender when it (ACDI-VOCA) was working with the group in a food security project. The stakeholders provided knowledge and importance of having the subgroups. The farmers divided themselves into subgroups basing on features such as gender, age and literacy levels. However, the subgroups were formed in a balancing manner so as to avoid instances such as forming subgroups with only women or a sub group with only people who cannot read and write. Thus even though the farmers were adapting this new knowledge on group formation, they adjusted it inorder for it to suit their contexts.

The group formation brought with it a well defined regulatory regime for managing group activities. Group members are supposed to follow these laws including the issue of paying subscriptions and fines in the event of breaking the law. The issue of subscriptions was not sustainable to some members. Even though the subscription amount is generally reasonable, it is sometimes a high amount for these farmers to pay and is one of the reasons why group members sometimes drop out or in some instances fail to enjoy group benefits. Currently, the group has 23 active members and 10 members which are inactive. According to the group constitution, the inactive members remain as members since they were part of the group when it was officially registered. Their inactivity is because they broke group rules and they need to rectify that before they start enjoying group benefits again.

Using the knowledge they acquired on group dynamics from Ministry of Gender, the group make and sell doughnuts during the time when there are no mangoes inorder to raise money to pay rentals for their premises. Following a duty rooster, one subgroup cooks and sells doughnuts at a time. After selling, the subgroup gives the money to the group treasurer and

waits for the next group meeting inorder to determine profit and loss from the sells when they are together as a group.

3.1.2 Mango production and management

The group falls in one of the areas which produce a lot of mangoes in Kenya. There have been various initiatives run by the government and NGO's aiming at improving the mango varieties and better production practices. The reasons behind these initiatives ranged from uplifting the standard of life of these farmers found in the drier parts of the country. Other reasons include helping farmers to get the most out of their mangoes and helping them produce the quality of fruit that will render them space in the mainstream commercial mango market including exports.

However, the export markets have regulations which the farmers struggle to meet. Firstly, the mango seedlings need to be inspected by the HCDA before growing them into trees. This was easier for the farmers because KADI had its seedlings inspected by HCDA before distributing them. KADI helped the group with mango seedlings as far back as 1992. KADI also trained the group on production of high quality mangoes for export and good manufacturing practices (GMP). KADI distributed seedlings of improved mango varieties such as Ngowe, Apple and Van Dyke. Later on as time moved on in the early 90's, KADI partnered with the Ministry of Agriculture in providing farmers with knowledge on good farming practices inorder to meet the requirements of the export market. Starting from 2010, Farm Concern started working with the farmers' group. Farm Concern is running a project working with Passion and mango farmers in the area. The Farm Concern project ran for three years from 2010 up to 2013. Farm Concern negotiated with pesticide companies and brought them near to the farmers so that they can get pesticides nearer and affordably.

However, even though farmers wanted to apply the knowledge on good production practices to produce the quality and standard of fruits that would put them on the lucrative export market; they failed to cope up with the spraying regimes and the appropriate pest control mechanisms. Therefore, they continued using their traditional methods of pest control and adapting to the new knowledge only when it suited their circumstances. The most two problematic pests which the farmers mentioned are the mango fruit fly and the mango seed weevil. The group mainly controls mango fruit flies through spraying though most of the times not according to the spraying regimes.

Most of the farmers have bought mango fruit fly traps inorder to keep their trees safe even if their neighbors do not spray their trees. The farmers feel that even though the traps are not as effective as spraying, they are a worthy investment. The traps have an advantage that they are a once off investment compared to continuosly buying pesticides. Another attractive advantage to the farmers for using fruit fly traps is that they keep trees in one's orchard safe even if neighboring farms are not sprayed.

However, the farmers throughout these years have been failing to meet the export standard requirements because besides production practices, the export market demands special methods, techniques and equipment for harvesting and handling mangoes which they do not have.

3.1.3 Mango processing

After getting lots of knowledge on better mango production and management, the mango production significantly increased. However, the farmers faced a problem of markets. Some brokers come to buy mangoes from them. The brokers had their own specifics of the mangoes that they wanted. This market regime path as dictated by the brokers, select and buy mangoes of a certain size, quality and specific stage of ripening. When brokers are coming to buy, the farmers harvest the mangoes in their own way which does not involve special handling techniques and so lots of mangoes get spoilt. The harvesting method practiced by the farmers takes down mangoes of all sizes and ripening stages from the tree. Such that after selling to the brokers, the farmers would be left with lots of harvested mangoes which the raw mango market does not absorb. The farmers approached ATDC asking for help on how to utilize the excess mangoes that were being left by brokers.

Inorder to avoid continuos mango wastage, in 2008, the Ministry of Agriculture through its Agricultural Technology development arm trained the group on mango processing providing knowledge and skills to the farmers. Mango processing demands equipment to enhance efficiency and hygiene. ATDC linked the farmers to the Arid Lands project. ATDC gave the farmers knowledge on writing proposals so as to get processing equipment from the Arid lands project. Arid Lands helped them with a machine for drying mangoes during the same year 2008. However, the dried mango failed to get a good market because the driers were making poor quality mangoes – the driers were not drying well so people were not buying them. Besides the driers which were not functioning well, the mangoes were having a bitter taste because of dipping the mango chips in lemon juice before drying. ATDC had facilitated the farmers on dipping in lemon juice for flavoring and preservation. However, the farmers experimented on their own as they tried to eliminate the bitter lemon taste. The farmers replaced lemon with dipping in a concentrated sugar solution. ATDC acknowledged the innovativeness of the farmers. However, the farmers said that using sugar was good for market but it was expensive to use sugar because they have a lot of lemons available in their farms which they were using at almost zero costs.

Since the driers were not functioning properly and the dried mango were not getting a good market, ATDC helped farmers with knowledge on making other mango products other than drying such as mango juice, jam, wine and nectar. On their own, farmers started manipulating the knowledge they had gained from ATDC in adjusting concentrations to suit different mango varieties and client preferences.

During the training sessions run by ATDC in 2008, the farmers got knowledge on how to operate the processing equipment and to maintain it. ATDC gave farmers knowledge during the training sessions on where to get preservatives and other inputs for making mango products. Preservatives such as citric acid can be bought in local spice shops and other things such as sugar and yeast are found in grocery shops. The farmers also learnt that they can replace citric acid with lemon as a preservative.

The farmers started mango processing in a single room which they were renting. After getting more and bigger equipment such as a pasteurizer and pulper, the group felt the room was small. Also, the small room which the farmers were renting did not have the electrical capacity called three phase electricity which is needed to operate the pasteurizer. The group decided to move into a bigger room to fit the equipment and electrical capacity. They had to look for money to go to the power company and ask for the three phase electricity so that they can operate the pasteurizer. The three phase electricity costed 65 000/- (approx. 584.88 euro). That time, in 2010, they had a customer from Naivasha (another town) who wanted lots of mango concentrate. The farmers were using a sufuria (a flat based, deep and handle less cooking pot) to pasteurize and so the customer said sufuria made concentrate does not qualify. So the farmers contributed the money towards the three phase electricity. They were also helped by the Ministry of Gender and Social Services with 30 000/- (approx. 260 euro). Other money was coming from selling mango juice locally since they cannot go out of Kanyuambora because customers outside Kanyuambora ask for the certification mark.

Their main customers are local hotels and restaurants as well as individuals. The farmers also sell doughnuts even when mango is out of season so that they raise money to pay rentals for the place they use. They sell a liter of juice for 120/- (approx 1. euro) and 300mls for 30/- (approx. 0.27 euro). The 300mls sell faster. They are making juice and not concentrates because the price of concentrates is high than juice and so it does not go faster on the local market. The group is looking forward to make and sell concentrates in supermarkets after getting standardized.

The Ministry of Agriculture through the Arid Lands project connected the group to KARI Thika when the Arid Lands project was about to exit. Kari Thika came on board when the Arid Lands project was withdrawing and so they had to choose a group to work with which was also doing mango processing as dictated by the Kenya Agricultural Productivity and Agribusiness Project (KAPAP) - APL II projects which was being implemented in the area through KARI Thika. KARI Thika after seeing what the group was doing and the progress being made also helped the group with a pulper and a deep freezer to store their mango pulp and concentrates.

Farmers got more processing information from KARI Thika. The group's ability to make and store more juice was greatly raised through the availability of the necessary processing equipment and freezer.

The availability of equipment significantly increased the production levels beyond what the community could consume. The farmers sell around their community shops and sometimes they receive orders from local eating houses in and around Kanyuambora. Due to the increased production capacity and limited market, the farmers started thinking of ways to expand the market beyond their community. Most of the times when the farmers tried selling outside their community, the people would ask for certification. That is how farmers became aware of certification.

Regulations in the food and beverage industry of Kenya require that foods and beverages intended for commercial purposes should be inspected and certified by the government body; Kenya Beruae of Standards (KeBS) before being sold to the public.

3.1.4 Certification

Since these farmers were processing their mangoes with the help of the processing equipment which they got from the government program, their production capacity sometimes went beyond what their local market can absorb. They sell their juice to the people around the shops. The people in the marketing subgroup take the processed products to the market, selling to the people around the shops. Sometimes, they get orders from people outside Kanyuambora in other places especially during functions but this is not always.

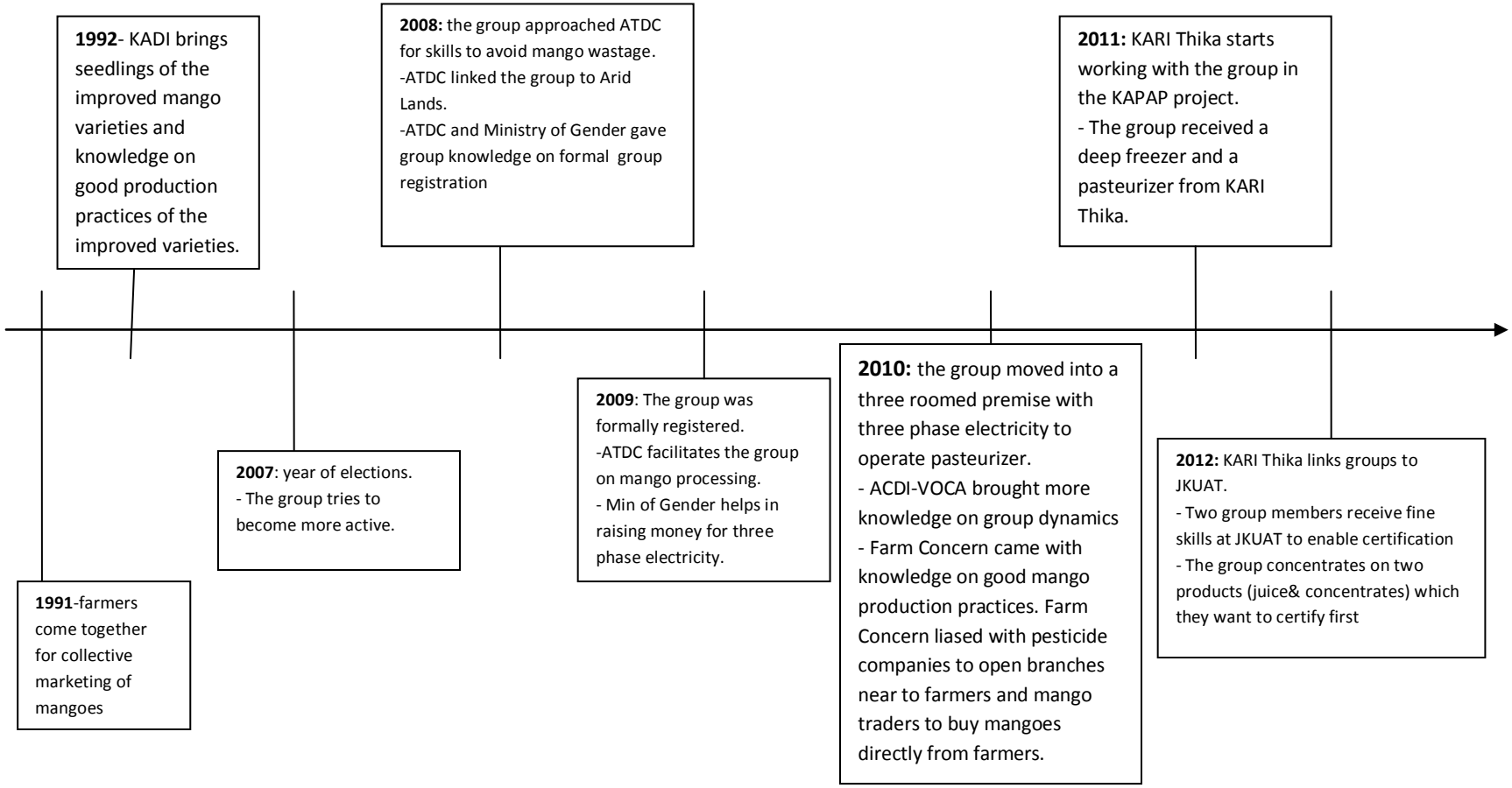
Therefore, in order to get a stable market, the farmers want to be able to supply supermarkets and to be able to sell in other villages outside their area. They have tried to do this but people outside their area who do not know them always ask for the certification mark.

Farmers do not have sufficient knowledge on their own on how to get their mango products certified since standardization is a new area for them. Therefore, product certification process is a difficult task for the farmers. The farmers are thankful to KARI Thika who sent two members from their group to Jomo Kenyatta University of Agricultural Technology (JKUAT) for a short course on skills required to meet the certification standards. The group members sent to JKUAT were taught more skills on value addition such as adding starch for juice thickening, using two preservatives to prolong shelf life of juice up to two years, getting a refracto meter for measuring sugar content, scale for weighing preservative as well as thermometers for measuring temperature of juice when heating it. The two who attended the training course at JKUAT, came back and shared the new knowledge with the rest of the group. KARI Thika has promised the farmers bicycles with a space for baskets in front. This type of bicycles will be very useful after getting certification so as to reach faraway places selling products. Until December 2012, the group's efforts were concentrated on getting certification.

The group pins its hope on certification that after they are certified then they can sell outside their communities as well as in supermarkets. Besides testing the products, KeBS also checks the premises where the products are manufactured. The components that are checked include

running water, floor types and infrastructure settings such as toilets. This group has managed to make up to the infrastructure that is required for certification through having premises with running water, the required floor type as well as protective clothing for hygiene purposes. The challenge of the farmers is now on making their product pass the test which they hope to achieve during the course of this year 2013.

Figure 4: Timeline summarizing events for Kanyuambora Mango Growers



3.2 Mururiri Self Help Group

3.2.1 Group formation

The group was formed initially in 2003 when farmers from three neighboring villages came together to help each other with farming chores such as planting, weeding, harvesting and collective marketing of their produce. The group at this time was a Common Interests group comprising like-minded people with bigger land and so wanted to reduce burden on labor through sharing tasks and finding markets together. However, as time went by, FAO came in 2004 with a project for Farmer Field Schools and so a lot of people joined. This Common Interests group was dismantled as each village had enough people to stand on its own. This then led to the formation of Mururiri Self Help Group. With the FAO project, the group was encouraged to get registered for formal recognition. In 2004, the Ministry of Agriculture provided them with knowledge on group registration together with counterparts from the Ministry of Gender. Being able to register as a group also means that they had to meet requirements such as coming up with group laws, having a group bank account and defined leadership structure. Having a written down leadership structure and following up rules were not hard things for them because they already have a traditional leadership structure which they follow. The Ministry of Agriculture gave the group knowledge on group dynamics soon after getting registered. ACDI-VOCA and NGO gave the farmers more knowledge on group dynamics in 2010 when it was running a food security project with the farmer group. The farmers got knowledge on importance of having sub groups for group activities and thereby removing the whole pressure on group management on the Chairman.

The group received knowledge on importance of subgroups and conducting meetings regularly from Ministry of Agriculture and ACDIVOCA. The farmers hold meetings every Monday afternoon during mango season and once per fortnight when mangoes are out of season. As time moved, members are dropping out one by one (currently 12 members) due to failure to abide by group policy rules- (for example. absenteeism from meetings, failure to update their subscription of their weekly membership). Some members were finding the value addition aspects and work of subgroups as too hard work and time consuming at the expense of their individual chores.

To ease flow of operations, the group operates with subgroups. Each subgroup has a chairman and vice chair responsible for spearheading specific group tasks. The subgroups are: processing, finance, marketing, tree planting/ growers and welfare; for visiting each other monthly to check on members. The group overall leadership consists of a Chairman, vice chairman, secretary and treasurer.

3.2.2 Mango production and management

The farmers are in an area which produces a lot of mangoes. They have both indigenous and exotic varieties of mangoes. However, the farmers have been increasing the production of exotic varieties out of their own initiatives since exotic varieties such as Apple and Kent fetch better prices on the market. Exotic mango varieties have several other advantages important to the farmers such as the ability to be intercropped since they do not occupy a lot of production space. The farmers need better knowledge inorder to improve the quality of their mangoes so that they can fetch a good market and good market price.

An NGO, ACDI-VOCA came to work with the group in 2010. During that time, the NGO was running a food security project in the area. The NGO project focused on crop production encompassing all traditional crops grown in the area. The group owns a farm left from the Conservation Agriculture project with FAO. ACDI VOCA used the farm of the group as a demonstration plot. ACDI-VOCA tried a variety of crops which are grown in the area such as maize, beans, cowpeas, green grams, millet and sorghum. The farmers could learn on farming practices from the demonstration plots so that they would copy and do it at their farms. The farmers say that they learnt a lot from the project and a lot of improvements could be witnessed on their farms. Diocese of Embu (DoE) a catholic organisation was also working with the group during the same time running its own project which was complementing the work of ACDI VOCA. Diocese of Embu helped the group with seeds for green grams, pigeon beans as well on savings and lending. Diocese of Embu trained them on production and marketing of their products as well as for the crops grown from the seeds that it provided the farmers with.

ACDI VOCA taught them also on proper use and application of fertilizers because the farmers say previously they did not use fertilizers. ACDI VOCA also improved the farmer's knowledge on mango production. The NGO organized a workshop in Thika in which the group chairman had an opportunity to attend and get more knowledge on growing the indigenous and improved varieties of mangoes. The chairman brought the new information to the group so that they can apply the information first on their group orchard and then improve the mangoes in their own farms.

The export market is a lucrative market opportunity for mangoes. However, the farmers do not have enough knowledge neither do they have the resources to acquire the necessary equipment needed to meet standards as dictated by the regulations operating in this area. Good enough for them, in 2010 Farm Concern an NGO, came into the area under its Passion and Mango program. Under this program, Farm Concern will be working with Passion and Mango farmers trying to improve their livelihoods through these fruits. Farm Concern project aims at making the farmers make the best out of their mango and passion fruits through removing the main barriers which as deduced from the areas of focus of Farm Concern are the issue of lucrative markets and regulations. Inorder to solve these issues, Farm Concern encouraged good farming practices and use of pesticides to improve quality of mangoes in the case of this farmer group. Farmers were given knowledge on spraying regimes by Farm

Concern with the help of Ministry of Agriculture. Farm Concern trained the farmers on good mango farming practices and brought pesticide companies near so that farmers can buy chemicals for spraying at a good price. Farm Concern encouraged collective marketing of mangoes and helped in linking farmers directly with mango traders because there were a lot of mango losses and farmers were getting poor prices from brokers. Before Farm Concern intervened, mango traders did not know that there were mangoes in Mururiri. Mango brokers were the ones who came to buy mangoes from the farmers and resell to traders. The brokers were getting the mangoes from the farmers at a very low price and then resale to traders.

Farm Concern also encouraged farmers to have nutrition gardens at their homesteads. The farmers acknowledge that Farm Concern really helped them and now traders are coming directly to buy mangoes from them. There are no more significant mango losses, no more brokers and so farmers are getting better prices for their mangoes compared to what they used to get.

However, the farmers appreciated the use of pesticides and the efforts made by Farm Concern but they said in as much as they wanted to participate in the lucrative markets, it was difficult for them to keep up with the spraying regimes due to financial constraints. The issue of money made it difficult for the farmers to stand up to the requirements of the export markets despite the knowledge of what was required. As a result all their mangoes were left onto the market with the main buyers being domestic customers from other towns who would buy the mangoes for resale in other towns and places. Still the domestic traders are selective in buying the mangoes choosing certain stages of ripeness, size and general quality. The area is characterized by poor roads so it makes it difficult for the farmers to take the mangoes to the market because the common mode of public transport on the poor roads and terrain are motorbikes. So it is difficult to take large volumes of mangoes to the market using a motor bike. Even though Farm Concern did a good job in improving the overall productivity of mangoes in the area and raising the levels of knowledge of the people, it remains unclear whether they had done a proper market research for the mangoes as well as providing alternative solutions to the market issues. As a result the farmers were left with some fresh mangoes which the traders did not take. Since they had equipment they used for processing traditional crops, they approached the Ministry of Agriculture office to ask whether they can be assisted with knowledge on mango processing.

3.2.3 Mango processing

The need to process mango was initiated due to excess raw mangoes which were left over by the buyers. Mango processing and marketing inorder to be successful requires technical expertise in terms of knowledge; on what and how to do it as well as the use of machinery. However, the group has been fortunate enough to have participated in the Arid Lands project which was running in 2008. This was during the time when they approached the Ministry of Agriculture for help on information on value addition of traditional crops as a way to keep group intact after FAO had left. The group thought of value addition of traditional crops available in the area so that they can continue to sustain group. The farmers approached Agricultural

Technology Development Centre (ATDC); a sub branch of the Ministry of Agriculture in their local township and were trained on value addition of crops (sorghum, millet). ATDC also gave them knowledge on writing of proposals to Arid Lands inorder to get processing equipment for the sorghum and millet which were currently being offered by the Arid Lands project. Arid Lands Resource Management project was a project within the Ministry of Agriculture which was run by the government of Kenya in collaboration with the World Bank.

During the same year 2008, the group received equipment in the form of a miller from Arid Lands project and started processing traditional crops; - sorghum& millet into sour porridge (which have a great market for functions such as weddings and other big gatherings), cassava and sweet potatoes into flour. The government (Arid Lands project) paid 70% for the cost of the machine and the group contributed 30%. The group made individual contributions for the remaining 30%. The 30% also included the cost of building the infrastructure which was to house the equipment and project activities. The seasonality of traditional crops and the amount of mangoes which could not be absorbed by the market made the group to think of other ways to make use of the machines. The farmers' group then approached ATDC to know if they can make the machine useful when traditional crops are off season through processing other crops such as mangoes.

ATDC trained them on mango processing because the miller they had received from Arid Lands can also be used as a mango pulper. Also because there were lots of mangoes in their area which were going to waste as traders were offering very low prices for them or because the mangoes fail to meet the quality required by the traders. The farmers could not take their own mangoes to the market due to poor accessibility of the area and perishability of mangoes. Even if they could, the market prices will also be low due to a mango oversupply during the mango season. However, later on they received a pulper from Arid Lands designed especially for mangoes which have a big carrying capacity as it can make 40 litres of mango pulp at one go compared to the miller for traditional crops which can only produce 5 litres at a time. Arid Lands supplied them with the necessary equipment specifically for mango processing.

The ministry of Agriculture is responsible for training the group through ATDC. The group feels that ATDC is their biggest stakeholder. ATDC helped them with training on mango processing and linked the group to the Arid Lands project where they were supported with all equipment necessary for mango processing. ATDC also helped the farmers with information also on crop production.

So the group got knowledge on mango processing through the Ministry of Agriculture.

However, some of the processing equipment that they received was irrelevant to their context because some function on electricity. The farmers received a pulper, a miller for sorghum, a pasteurizer, a machine for packaging as well as other equipments such as thermometers and weighing scales. Machines such as the pulper and the machine for packaging are driven by electricity only. The farmers' premises do not have electrical power. Therefore during periods

when they receive bid orders for juice, the farmers use the pasteurizer at ATDC premises which has a big carrying capacity of 400 litres. Otherwise, the farmers use big pots to pasteurize manually.

The farmers process several other crops such as sweet potatoes, cassava, sorghum, millet and paw paws but for mango they make mango chutney, wine, juice and jam using both local and improved mango varieties (they have both types of varieties in their farms.) The farmers are doing everything by themselves. They do not have people working for them. They have premises consisting of a 3 roomed block where they keep their processing equipment and products.

Using the knowledge on group management and dynamics, the group markets its products through the marketing sub group. They make juice and wine selling around the community, neighboring villages and also during functions. They also supply a local hotel with juice. However, to fit context, they dropped other product such as jam and chutney and they just keep samples of these at their premises. These samples they use for showing to visitors who come to witness their group activities. So through Ministry of Agriculture (ATDC), the farmers got knowledge on how to make mango wine, juice and jam. Other stakeholders also came on board with more information on Mango processing such as KARI Thika and Jomo Kenyatta University of Agricultural Technology (JKUAT).

The ATDC staff withdrew in 2011 at the end of the Arid Lands project before they had taught the group on packaging. So the group was making products however with a not so good shelf life and dull packages. The packages were dull because the group did not have enough knowledge and resources to invest in labels to enhance marketing. Due to the unreliability of the local market, they sometimes take too long to sell a small batch and so the need to get certified so as to be able to diversify market.

3.2.4 Certification

The farmers' quest to certify their mango products was initiated by the need to expand the market for their products. They have the least knowledge on certification on their own and so they depend on knowledge coming to them from external stakeholders.

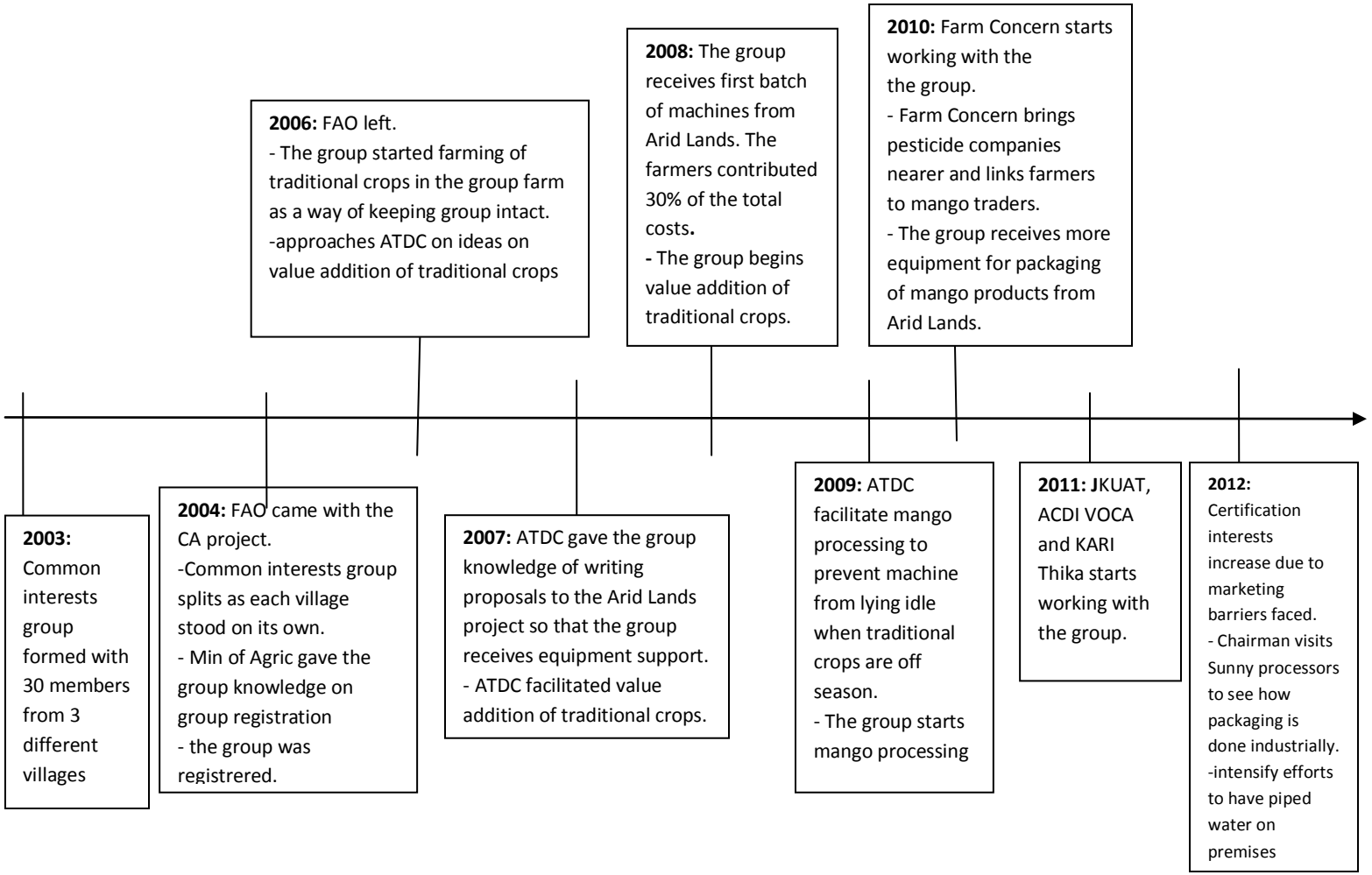
Ministry of Agriculture (ATDC) explained the certification of their mango products after the farmers discovered that they were failing to get access into the formal market because their products were not certified. ATDC explained to them that they had to raise money so that their product samples can be analyzed. Also it was important for them to have clean running water on their premises since running water is one of the prerequisites for certification. However, their area have no piped water as yet but they were hoping that by February the piped water would be available to them since the water company had already dug a trench and laying pipes which could supply water to their premises.

Since money was needed, the farmers had to choose the top two products which they wanted to be certified first. They choose juice and wine considering their context that a lot of people in their area buy juice and wine. However, regimes somehow make it difficult for the farmers because raising the 32 000-/ and 5000/- for testing samples of wine and juice respectively was very difficult for the farmers. Still even if their wine was to pass the test, they will again be faced by the regulations governing packaging materials. Wine need to be packed in bottles and the locally available bottle moulds are owned by companies which will need to be paid first so as to be granted permission to use their bottle moulds. An alternative would be to import but the farmers are faced by the issues of inadequate finances.

Processing and packaging imparts directly on certification since both factors contribute towards having a good end product that can meet the certification requirements. However, ATDC did not finish with them everything on packaging and how to use the packaging equipment because the Arid Lands project ended before they finished on packaging. The activities of the ATDC staff were funded through the Arid Lands project. Therefore the farmers do not have sufficient knowledge on packaging procedure to enable them to get certified and they seem to be facing challenges in this regard. From the samples they sent to the KeBS laboratory for testing, the farmers were told that their juice had a high percentage of bacteria which could be due to product contamination. This contamination might occur during pasteurization of juice which is done under an open fire in big open pots known as sufurias or due to packaging in unsterilized containers. Even though the farmers received a pasteurizer among other processing equipment from Arid Lands, they cannot operate the machinery because it runs on electricity. There is no electricity on their premises.

The farmers sent their group chairman to a processing commercial company; Sunny processors, to observe and get knowledge on how packaging is done commercially so that they could improve on their own. They noticed that commercially, packaging is done under a vacuum into sterilized containers. The farmers do not have the technological equipment to create vacuums. They therefore improvised and decided to fill the juice containers to the brim so as to eliminate air from the containers. Though this method managed to extend shelf life of products, it however failed to reduce percentage of bacteria in the juice as reported by laboratory tests. Products need not exceed a certain percentage of microbes' inorder to be certified.

Figure 5: Timeline for Mururiri



3.3 Kareri Kwimenya Self Help Group

3.3.1 Group formation

The group was formed in 1994 through farmers own initiatives. The reasons behind the group formation were as influenced by the farmers' circumstances and context such as uplifting the living standards of each other through agriculture. The binding factor among farmers making up this group is that most of them did not have enough money to buy seeds and fertilizers for their own fields to ensure food security. Also, the group comprised mostly of women since women are the ones in charge of their family kitchens in this context and who have to prepare food for their families. Children would trouble and ask food/ tell their mothers if they are hungry. Therefore the women (mothers) are mainly affected by food shortages both physically and psychologically as it is difficult for them to stomach the sight of their hungry children in periods of food shortages.

Therefore they came together as a group to farm collectively, contributing the minimal resources that each one have and then sell the crops among themselves at a price affordable to themselves. They also have group contributions of 20/- every month for a goat project. A goat costs between 1400 -2000 /- , roughly equivalent to between 12 – 18 euro. Therefore the group buys two goats at a time and then two members get a goat each.

So the group was formed but it did not have a defined or written down group structure. The women managed their group using traditional leadership styles. However, in the late 90s KADI worked with them on mango seedlings of improved varieties. KADI introduced the group to GTZ as a buyer for their improved mangoes. Inorder to work with GTZ, the group was supposed to be formalized through registration. They got the knowledge and facilitation on the registration process with the help of KADI and the Ministry of Agriculture. They opened a group bank account, came up with group by laws to abide by and a written down group structure. The farmers blended this new knowledge on group management with the knowledge they already had on group dynamics. So the group was registered under the Department of Social Services and adapted to the new system of working with written down by laws and interpreting them. During this time, the group had between 30-40 members.

Currently, the group consists of 20 members with 19 women and only one man. The group used to have a total of 8 men. New members are still welcome provided they pay 1000/- to cover up costs and contributions that the other group members have already paid and contributed since inception of group. Also new members would be required to pay weekly contributions before they start participating in the group lending scheme as well as attending group weekly meetings which are held every Wednesday morning at 10.

3.3.2 Mango production and management

KADI came to work with the group when it was running its own programme of supporting improved mango varieties to communal farmers and so it came into areas through the farmer groups. This way the farmers managed to get seedlings for improved varieties and to have their own experience with them during the early 90s. Together with the Ministry of Agriculture personnel, KADI provided the farmers with good production practices of the improved varieties. KADI encouraged the farmers to adopt the improved varieties alongside the indigenous varieties they had already. This was because both varieties complement each other since the weaknesses of one variety are the strengths of the other. The strengths of the indigenous varieties are that they are disease resistant and they are cheaper to grow since farmers where producing them without much crop husbandry. The indigenous varieties can also withstand the amounts of rainfall that are received in this area. However, the indigenous varieties fetch poor prices on the market because they contain a lot of fibre. Also KADI wanted the farmers to have their own experiences with the improved varieties. Increasing mango production will also improve their source of income as the farmers could source mango market outside their localities.

A lot of farmers adopted the improved varieties in this group. Most of them are mango farmers and they complain a lot because of the mango weevil and mango fruit fly which is harboring them from exporting. For example, the group chairlady owns over 150 mango trees and acknowledges the trouble by pests. This makes her to just sale her mangoes cheaply in Kiritiri (their nearest big market). The weevil affects the mangoes and makes them not suitable for the export market.

Despite encouragements to follow spraying regimes the farmers simply do not abide by them. They argue that chemicals are expensive to buy and so the method is not sustainable to them. Therefore they use ashes around tree barks to prevent ants and they also burn green tree leaves to scare away pests such as the mango fruit fly during the flowering stage when they know that it is during this time that the trees are usually attacked. The other issue hindering mango production in their area is the issue of water. The farmers have come up with a way of preventing their trees from the effects of drought. They cut the tree branches on top so as to reduce the amount of water the tree lose and this helps in making the mango trees survive the drought.

The Ministry of Agriculture has been working with the group for a long time. In 2011, the Ministry arranged workshops with other government ministries such as the Ministry of Trade and Industrialization. The aim of the workshops was to expose the farmers to what was happening beyond their villages so that they could get knowledge and understand that they were various opportunities for selling mangoes. Japan International Cooperation Agency (JICA) was present during such workshops as a prospective market linkage.

3.3.3 Mango processing

The group did not have knowledge for lucrative mango markets. KADI linked the group with GTZ as a buyer for their mangoes. GTZ wanted to buy dried mangoes. However, the farmers did not have the knowledge and equipment necessary for drying mangoes. At the same time they did not have money to buy the equipment or to pay for acquiring the necessary expertise. Therefore, since Ministry of Agriculture had been working with them together with KADI it facilitated their training on mango drying. KADI also facilitated that they strike a deal with GTZ to get drying equipment on a lease agreement. To suit their contexts, the mango dryers were solar powered. The farmer group did not have a premise for processing and storing dried mango in a hygienic environment so as to maintain the quality and standards demanded by GTZ. Since they were being paid, they managed to rent a classroom block to use for mango processing.

From 1998, the group started mango and tomato drying, selling to the Germany Agency for Technical Cooperation (GTZ). GTZ was buying dried mangoes at 300/- per kg (approx. 2.71 euro). They were selling to GTZ because to them, it was buying with good price unlike selling on the local market like what other groups do. The money which the group got from the mango sales, they shared amongst themselves. The mangoes which were used in drying were bought from the amongst the group members and in some cases from the other villagers in the community. The farmers bought the tomatoes for drying from the market in Kiritiri (the nearest big market).GTZ was the only reliable market they knew at that time for their dried mangoes and GTZ was paying them handsomely for the dried mangoes. Most of them confirm that their lives changed significantly for the better when they still had GTZ as their customer. They dried the mangoes as a group and would then share the profits from the sales after being paid.

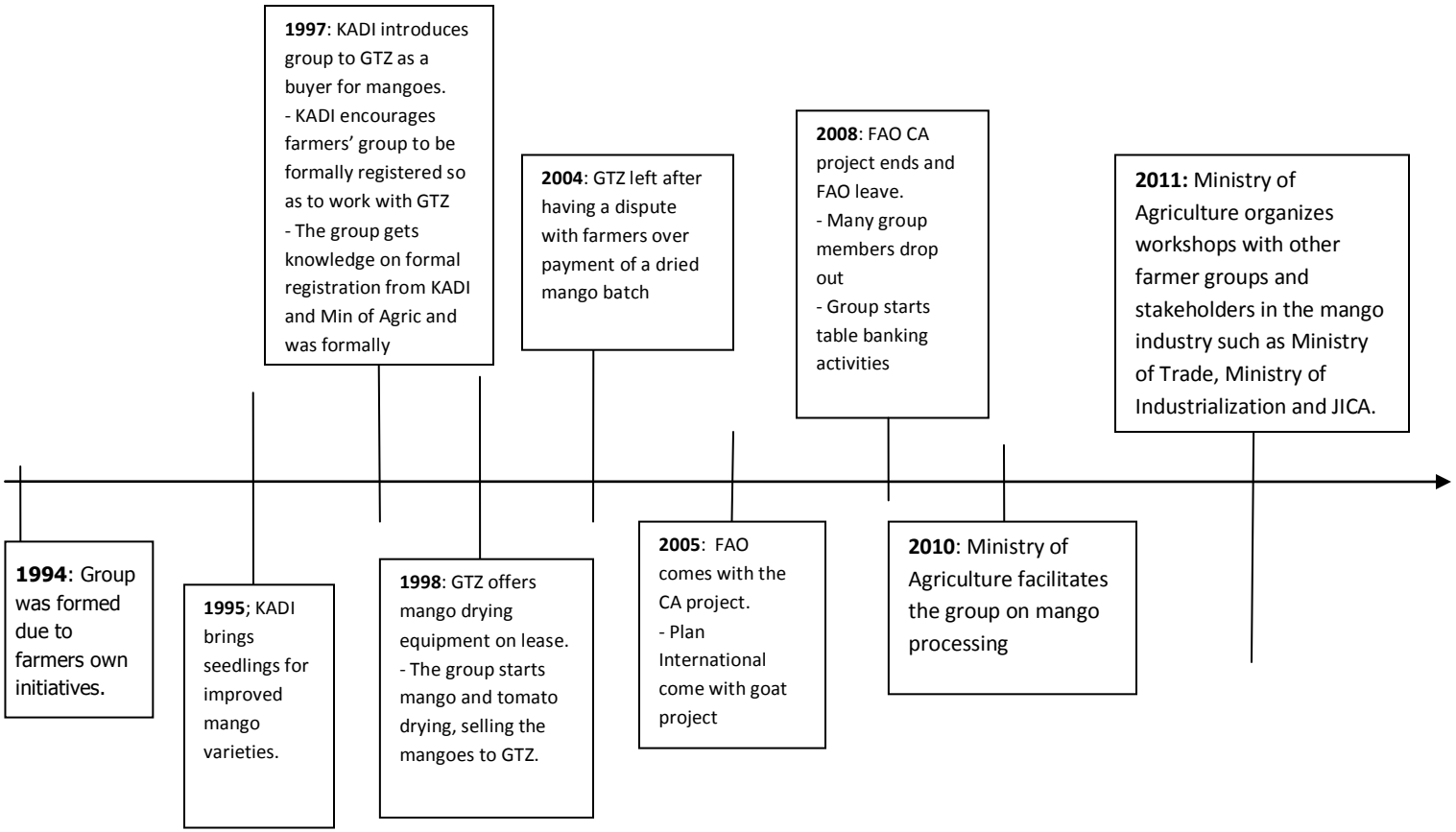
However, things went sour with GTZ when they supplied a batch of mangoes and GTZ failed to pay stating that the batch was of a poor quality. The farmers argued that they had supplied same quality as they always did. Sadly, there was nothing that the group could do about it because they do not understand the laws surrounding their circumstances and so their knowledge was limited. So they pulled out of mango drying since they could not secure an alternative buyer on their own. They did not know where to start in finding one. Finding an alternative market for their dried mango was also difficult for them because they were used to good money from GTZ and so it was almost impossible to get a similar paying market.

Ministry of Agriculture came in and gave them knowledge on making other mango products such as mango juice, jam and wine without the use of processing equipment. Currently, the group is mainly working with the Ministry of Agriculture. The ministry of Agriculture trained them on mango processing and the officer who trained them pays them field visits regularly on Wednesdays when they have their group meeting to check on how they are doing. The Ministry also organized a workshop for the farmers in 2011. The aim of the workshop was to improve their knowledge and to facilitate them on getting exposure and ideas to create small cottage industries so that they can process their mango products in a cottage industry. However, the

group members were not interested and are still hurting from the GTZ experience and so they just produce mango juice for consumption in their homes. They sell their raw mangoes at the local market at very poor prices because the mangoes are not sprayed so they are of poor quality.

The group now is mainly sustained by table banking. NGOs have been coming with projects to the group. These include Plan International working which worked with the group in a goat project. FAO came with the Conservation Agriculture from 2005 until 2008. The activities with NGOs have also been helping in keeping the group intact. After FAO left, the group started Savings and Internal Lending Community (SILC). Each group member contributes a certain amount of money as they please and then the money is used for borrowing amongst members. When returning the money, it should possess a 10% interest of the borrowed amount. At the end of the year, the group divides the interests amongst themselves using the amount of money that each member has contributed. In other groups, the SILC is called table banking.

Figure 7: Timeline for Kareri Kwimenya



3.4 Mbeere South Community Empowerment Initiative

3.4.1 Group formation

The group was formed through the farmers' own initiative as a result of contextual factors. The area is found in a dry land and it experiences frequent water shortages. As a result a group of farmers came together in 2009 and formed the group though without formal registration. The farmers ran the group using their own knowledge coordinating each other in building themselves dams. Another reason behind formation of the group was to engage youths in the community lying idle due to lack of employment. So the group would build dams for other people even outside their community as a form of employment and get paid.

The local Ministry of Agriculture office had always been in contact with the farmers in the area. Another time when a Ministry of Agriculture official from the local office, came to the village on a routine village, she noticed that there was a group already formed. The official told the group that there was a donor who wanted to support group projects so inorder to qualify and get recognized by the donor, the group sought help from the Ministry of Agriculture since they did not know how to get formally registered. So the Ministry of Agriculture official helped the group throughout the process explaining to them what they were supposed to do and what the requirements were. Ministry of Agriculture also organized a workshop attended by the group representatives where the farmers also learnt on group dynamics. So they opened a group bank account, came up with group by laws and a well defined group management structure. Like all the other groups, the group also has sub groups for performing special group tasks such as production, processing and marketing.

The group is registered with the Department of Social Services under the Ministry of Gender and Community Development. Currently, the group has 11 members from 15. Some members dropped out because maybe they could not get what they expected since no donor turned up and also because some wanted to pursue and give more attention to their sources of income but most importantly, members failed to abide by group rules especially the one for attending every meeting.

Group members do not pay subscriptions. They just contributed 500 KSH inorder to raise funds needed formalizing group registration as well as 400 KSH when they decided to start a goat project. According to them, they have not encouraged new members to join so no new members have joined and they seem comfortable with their membership number.

However, the District Home Economics Officer (who works more closely with the group and trained them) said that the main reason why the group was formed is that they were just looking forward to get funds from donors. That is why they were quick in opening a bank account. Also she says it explains why they don't pay group subscriptions as what other groups do because the reason behind them forming a group was to attract funds.

3.4.2 Mango production and management

This group mainly grows indigenous mango varieties using traditional knowledge. They have not had any linkages to stakeholders introducing them to the improved varieties so there are very little amounts of improved mango trees one can find in this community. This may also have been influenced by their settings because this community is located beyond, in an area with very poor accessibility. The roads are very poor and the main mode of transport is motorbikes. Even myself I used a motorbike to get here most of the times. The farmers still somehow feel content with the indigenous variety because they hear that the improved variety is susceptible to pests especially the mango weevil so the improved varieties are expensive to maintain. The farmers like the indigenous variety because it is better adapted to their contexts and so they grow it without worrying much about any form of crop husbandry.

Therefore the farmers have stuck to farming of indigenous mango varieties with very much limited influence from external stakeholders to adopt improved varieties. They control pests using traditional methods.

The group members also took the opportunity whenever they met as a group to sensitize each other on HIV/AIDS issues. The group chairman has knowledge on HIV issues after having participated in one of the trainings run by Ministry of Health in 2003. So during the group meetings, he takes the opportunity to share and discuss HIV issues with group members as they run their group activities.

As the group continued with its activities, they realized their other problem was mango wastage and so thought of ways to utilize the mangoes which are in abundance in their area. Their mangoes were being wasted; many were getting rotten under mango trees. There is a lot of mango in the area since almost every person owns some mango trees. The local market was offering poor prices making the selling of raw mangoes unprofitable.

During the course of 2011, the farmers decided to approach the Ministry of Agriculture office for ideas on what to do with the excess mangoes.

3.4.3 Mango processing

Due to reasons related to the poor accessibility of their area, the mangoes that the farmers produce face problems in reaching the market and so most of the mangoes get wasted. The group members discussed among themselves about the losses but did not have knowledge on how to prolong shelf life or preserve their mangoes so as to prevent losses. Therefore they approached the Ministry of Agriculture office for their area through their group chairman for ideas on how to solve this problem. The group chairman after agreements with the group visited the Ministry of Agriculture offices in the area to ask if they can be assisted through some training so that they can utilize the mangoes they produce in a better way. They decided to approach the Ministry which often helps them with production information. The Ministry of Agriculture advised them on mango processing; an initiative which was taking place with other

mango groups around Mbeere District even those who did not grow indigenous varieties. The Ministry of Agriculture helped the farmers with knowledge on processing mangoes into products such as jam and juice which have a long shelf life than fresh mangoes. So the group got knowledge on mango processing from the Ministry of Agriculture through the District Home Economics officer in 2011.

The group was trained on mango processing into juice and jam in 2011. They started selling the mango juice in the community. However, the color of the juice was similar to a certified brew in beer halls and other alcohol shops. Often, some people would buy the juice thinking that it's the brew and after tasting and realizing that it is not the same, they started complaining. The members thought of how they can improve their product to satisfy their customers. They then thought of a way to introduce some alcohol into the product. They consulted with Ministry of Agriculture again on how the juice can be improved from juice to wine and Anne (the District Home Economics officer) trained them again on how to make mango wine. The group is successfully making mango wine that has increased the demand of their product locally (in the village). However, the context has influenced the group a lot in choosing the type of products to make. For example, the group quit making mango jam. This was because jam cannot be taken on its own and needs an accompaniment (bread) which the villagers occasionally buys from the shop, and even when they do, jam is often taken as a luxury so the demand for jam was very low. As a result, the group has dropped making mango jam and is now only concentrating on making wine and juice until when they can produce jam for wider market that is after they get certified.

Through their own experiences, they adjusted mango concentrations since there are different varieties of the indigenous species. The farmers have also been coming up with juice and wine for other fruits available in their area such as paw paw, guavas and mandarins when mangoes are out of season.

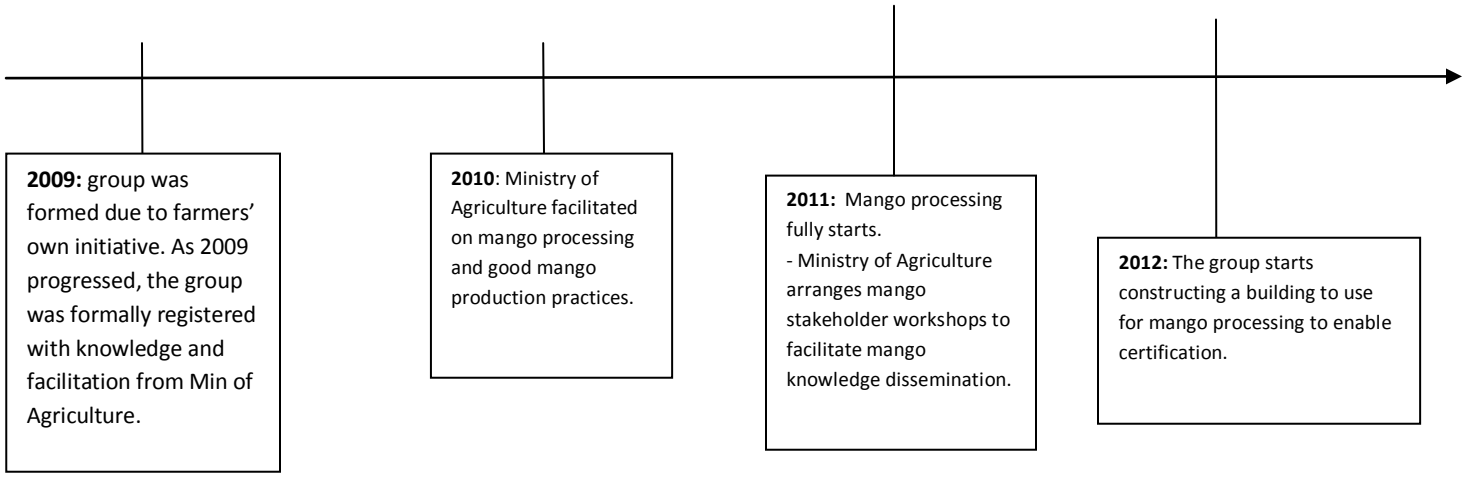
The group does not have any processing equipment. Therefore they produce little amounts of mango products since the process is manually done. They sell the products on the local market that is around their community. Late 2011, the Ministry of Agriculture official who was working with the group organized a training workshop for the farmers so that they can learn more on group management dynamics. Several stakeholders were invited to the workshop including Ministry of Trade and Industrialization as well as JICA. Farmer groups in Mbeere South District were as well invited including the Kareri Kwimenya group. During the workshop which lasted for a week, the farmers got knowledge on small cottage industries and how they can access markets. JICA was the stakeholder present on this meeting which promised to link them into the markets. So the farmers equipped with the knowledge on cottage industries became eager and enthusiastic on coming up with a cottage industry for mango processing.

3.4.4 Certification

The group faced resistance when they sold their products to some police officers who asked them for certification and so they felt a bit intimidated. Combined with the information they got from the workshop, the farmers were feeling the need to get certified so as to operate as a small cottage industry. The farmers are hoping that a cottage industry will open doors for them into the market and solve some of the issues which brought them together in the first place such as lack of employment and fresh mango wastage.

However, the farmers did not have knowledge on how to go about the certification. The ministry of Agriculture officer who had been working with them explained to them the process because she was also involved in the certification process with a women's group who are in a soap making project. Certification demands certain levels of standards which require being set first before anything else can be recognized. They need to have a shelter to use for processing since they are making food. Also, it is important to have some processing equipment inorder to minimize contamination. This requires money and expertise. However, these farmers do not have the money nor any experience with such type of equipment. However, the group chairman has volunteered to build a structure using his own resources and then he would rent it out to the group to use for processing. No one really knows how long he will take to finish the building but he promised that it was not going to take time since he is a builder himself and have already gathered all the material necessary for putting up the structure. The group has been fortunate enough to have piped water already. Therefore after the structure is available, they look forward to inviting the KeBS staff to their site so that they can be registered. The farmers were told by the officer (from Ministry of Agriculture) they work with that KeBS can certify them even if they do not have special equipment but produce a good product meeting the standard.

Figure 8:Timeline summarizing events for Mbeere South Rural Empowerment Initiative



CHAPTER 4 :RESULTS AND DISCUSSION

4.1 Introduction

The chapter explains the challenges which the farmers face as they move along the innovation path. It compares the challenges faced by these farmers together with similar case studies from other research, especially that in the JOLISAA program. The chapter also comes to a conclusion that as the farmers move along the commercialization chain, towards increased market integration, they also seem to move away of their comfort/knowledgeable zones and finding themselves in situations in which their knowledge became inadequate to deal with the challenges arising. Therefore they become more vulnerable and tend to increasingly rely on external stakeholders for support. The coming on board of external stakeholders seems to propel innovations forward as witnessed in the cases. The timing of exit is also important since if the innovations have not developed enough, the growth becomes stunted. The four mango cases show that the groups which enjoys/enjoyed more stakeholder support than the others are rightly ahead in their innovation path and a significant difference is evident compared to the groups with little stakeholder interactions. This indicates that farmers come across several challenges in the innovation process that are difficult to overcome without the external support. The concept of the strategic niche management and the innovation systems approach helped to analyse this process.

4.2 Challenges faced by the mango farmers in gaining market access

The mango farmers faced a lot of challenges as they try to penetrate the market which they do not have enough information on how it operates and have limited control over the market factors and conditions. The challenges faced by the farmers in the mango case, start from getting seedlings to put into the ground until the fruit reaches the final consumer.

Even though interlinked, the challenges can be broken down and looked into at four stages which the mangoes in one way or another pass through. The stages are:

- The farm/ production level
- Processing level
- Marketing of raw mangoes
- Certification and Export

4.2.1 The farm level/mango production stage

One of the main challenges faced by the farmers at the production stage is lack of quality planting materials. Inorder to produce a good quality mango fruit, the quality of the seedlings is important. Poor quality seedlings produce poor quality mango fruits which fetch poor prices on

the market. Three out of the four farmer groups in the mango case have had opportunities to get good quality seedlings of the improved varieties from KADI. KADI is a Catholic based local NGO. Generally it is difficult for the farmers to get enough clean seedlings for their orchards because nurseries for these are usually run by private companies and the seedlings are expensive for the farmers to purchase on their own. Inorder to get seedlings of improved varieties, the input of external stakeholders is generally required as evidenced by the fact that the groups who farm improved varieties were given the initial planting stork by KADI. This is also the reason why it is difficult for farmers to replace the old trees with good planting material because the farmers said they cannot afford the price of the seedlings. None of the farmers' groups could buy the seedlings on their own without the input of external stakeholders. KADI also brought knowledge to the farmers on the production of improved varieties.

However, this KADI improved seedlings project was run in the early 90s. Mango farming is an ongoing process which requires a continuos supply of good quality seedlings needed inorder to be able to replace old trees and cultivate new mango trees. The farmers are then left with only two options: either to buy certified seedlings from private companies or to source planting materials from their own farms. The farmers usually go for the latter because they do not have money to pay for the seedlings which are priced too high for them. However, one group Mbeere South still failed to have any stakeholder coming on board to assist with seedlings for the improved varieties which fetch a good market because they have less fibre. So this group still farms indigenous varieties. Indigenous varieties trees grow too big and reach heights that make it difficult to spray the trees for pest prevention. The quality of the fruits is reduced.

Therefore quality planting material of improved varieties seems an important issue for these small scale farmers for which an outside provider is apparently needed.

There is also need for continuos adaptive research as well as well established information dissemination channels for making information reach the farmers timely. Continuous research is important for getting varieties which suit the agro ecological conditions also in the face of climate change. Information is also important for farmers to know where they can get seeds and all other relevant production information. There is the government board the Horticulture Crops Development Authority (HCDA) responsible for disseminating information on mango production and nurseries but the farmers do not know about it. The HCDA regulates the mango industry in Kenya and is not known by the farmers in these mango groups.

There is also lack of knowledge and money to acquire input technology necessary for production efficiency. This includes motorized pumps for effective pests and disease control. Also there is practically no application of fertilizers and pesticides because farmers lack the money to invest into these. Even though Farm Concern have worked with two groups providing them knowledge and liasing with pesticide companies to have them operate from nearby, still farmers fail to cope up with the spraying regimes and having enough money to acquire the necessary pesticides.

Another issue affecting mango production is water availability especially for the groups in the southern part of the District (Kareri Kwimenya and Mbeere South) where there is minimal rainfall water. Naturally this part of the district receives less rainfall. The situation is made worse due to climate change which making the rainfall patterns unreliable. Improved varieties are mostly affected by moisture stress. The farmers usually lose a lot of fruits due to flower and fruit fall due to poor crop management. This makes them fail to produce the quality of fruits that will be competitive on the markets with a good price. The Kareri Kwimenya group grows improved varieties and is located in this part of the district. Efforts to save their trees from water stress have made the Kareri Kwimenya group to discover that cutting the tree branches at the top helps the tree to survive the dry period. This invention is called pollarding. However, pollarding saves the tree from dying but the tree will not be able to bear fruit during that season. Production is reduced.

Farmers in this part of the country have a single mango harvesting period unlike their counterparts in the Coastal region who have two mango harvesting periods. Therefore the mango harvest period falls at the same time with the harvest period for the other farm crops. Farmers in this region especially in Mbeere North (where the Kanyuambora and Mururiri group fall) practice crop diversification inorder to have multiple streams of income. This is also because the northern farmers receive more rainfall than their counterparts in the south (Mbeere South and Kareri Kwimenya). Other crops produced in Mbeere District other than mango include sorghum, millet, beans, green grams and maize. These crops share the same harvest period with most of the mango varieties. Therefore farmers will need to divide their attention to the mangoes as well as the other ripe crops. This calls for a lot of labor. This therefore leads the farmers to divide their attention among all the crops in need of attention at the same time.

The differences in production regimes for improved and local varieties are another major concern to the farmers which hinders production efficiency. The farmers are used to producing indigenous varieties with little crop husbandry. Improved varieties require a lot of attention as well as knowledge and support from institutions with information and money to invest into establishing and sustaining the orchards.

Overally, the risks and uncertainties involved as discussed above during the production period ranging from pests and disease prevalence, unreliable rainfall patterns, poor information flows and price fluctuations of market prices for both produce and inputs makes farmers fail to produce effectively.

4.2.2 Processing

The farmers lack appropriate processing equipment, technology and infrastructural capacity to be able to produce the quality of products with added value which are viable on the market. The farmers lack both knowledge and capital for mango processing. This requires the input of external stakeholders to be acquired. This is evidenced by the fact that the groups (Mbeere South and Kareri Kwimenya) who did not have any stakeholder coming to them with equipment

support did not manage to acquire it on their own even though they need the equipment. The Kareri Kwimenya group only had drying equipment when they were drying mangoes for GTZ.

However, two of the farmer groups (Mururiri and Kanyuambora) have been fortunate enough to have stakeholders who gave them the knowledge and processing equipment to use for mango processing. However, for Mururiri group, ATDC who was the main stakeholder giving them knowledge on mango processing, withdrew before the group got knowledge on packaging despite having received the packaging equipment. This is because the ATDC staff was funded by the Arid Lands project to help the farmers with the knowledge. Therefore when the project ended, ATDC staff could not continue giving the farmers the knowledge and so the farmers ended without the complete set of knowledge. Packaging is a new area to them and so they depend on external knowledge sources inorder to be able to do it properly for their processed products. Poor packaging techniques spoil a good product. It is also important on the side of institutions to be consistent in keeping their roles active as this help in propelling innovations forward.

Infrastructural elements such as electricity availability are also a challenge. Electricity is especially important for powering processing equipment when making juice and other mango products. Electricity is also required for powering refrigerators for storing sap to later process into mango products especially during harvest times. One mango group Kanyuambora has been fortunate enough to have electricity and so they operate equipment for processing and can freeze their mango concentrates to later process when mangoes are off season. Three of the groups do not have electricity. This made one of the groups in the mango case (Mururiri) fail to use some of the machinery they have because it can only be operated by electricity. On their own, the farmers cannot afford to pull electricity to their homesteads. They require support from government and institutions which can make the costs affordable. Government initiatives such as the rural electrification programme can be useful in addressing this situation. The same applies for Mbeere South and Kareri Kwimenya. The Mururiri and Kareri Kwimenya group do not have running water to start with and so aiming for electricity will be a little bit over ambitious. The farmers are concentrating on getting piped water first in the case of Mururiri and Kareri Kwimenya. Mbeere South is aiming at building a proper infrastructure to house their group activities. The groups have a sort of hierarchy of needs whereby electricity comes after having a building and piped water. However, electrical power is important for powering equipment technology which is commonly used in modern day innovations. The Kanyuambora group is located along a busy road and marketing centre which links Nairobi to Isiolo (a town before the Kenya- Ethiopia border). The road also links Kenya and Ethiopia. Kanyuambora group housed its group operations on a business centre located along this route. However, at one point in time, they had to change rooms so as to get a bigger room with enough electrical capacity called the three phase electricity so that they could operate their pasteurizer. They were having a customer who wanted large amounts so juice and so the need to use a pasteurizer to produce a good quality product.

Electricity runs equipment and reduces direct handling of products aiding the hygiene standards. Lack of electricity even in the event of processing equipment as is the case with Mururiri greatly compromise product quality in the face of certification and getting stable markets for products.

On a broader perspective, a very small quantity of mangoes produced in Kenya is processed through local processors into juice because of the quality of varieties which are not suitable for juice. Main players in the processing industry require mangoes of high quality mainly from improved varieties which should be free from pests and diseases. Farmers have a challenge of meeting this condition as discussed under production challenges because of financial constraints. Also literature points out that major processing companies such as Delmonte and Sunny Processors have an alternative to import mango pulp from countries such as Egypt and South Africa (FAO, 2008). This makes Kenyan processors not to utilize the domestic supply fully. Imports are made possible due to the organizational and institutional arrangements at policy level. These allow flexibility of trade and tariffs because of the provisions of trade agreements such as COMESA. Delmonte owns a pineapple plantation. However, the company has been involved in mango processing and had partnerships with farmers for contract farming.

Even though two of the farmer groups (Mururiri and Kanyuambora) have received processing equipment, they still have a challenge on certification and therefore they cannot process all the mangoes they produce since their market is still constrained to their localities. Therefore the need for an alternative raw mango market is still there. The other two groups (Mbeere South and Kareri Kwimenya) conduct mango processing manually and they have not been fortunate enough to have stakeholders assisting them with acquiring mango processing equipment. Kareri Kwimenya group owns some mango dryers but they are no longer putting them into use because they do not have a market for dried mangoes or knowledge on how to find a sustainable market.

Successful mango processing among the farmer groups is hindered by several challenges also of institutional and organizational nature including the role of policy and external stakeholders. All these challenges makes mango processing a difficult task for small holder farmers especially in the absence of supporting stakeholders who help in buffering the environment.

4.2.3 Marketing

Inorder to increase incomes, it is important for smallholder farmers to be competitive on the markets (Markelova et al., 2009). Mangoes can be marketed either as raw mangoes or as processed mango products. Processing adds value to the mangoes through turning the mango into a variety of products which can be consumed in different forms such as dried mangoes, mango juice, wine, nectar and ice cream. Through processing, the shelf life of the mango is extended and the mango is preserved which would have otherwise been wasted if they were kept in their raw form. Value addition also makes the mangoes fetch better prices on the market. The farmers' groups engaged into mango processing mainly as a way of addressing

some of the challenges associated with raw mango marketing and taking advantages of processed mango.

However, markets in developing countries are characterized by a lot of issues acting against the farmers' efforts to become competitive market players (Markelova et al., 2009). The marketing issues witnessed in the mango case are discussed below. They include for both processed mango products and raw mangoes.

- Most of the small holder farmers are located in remote areas with poor road networks and without electricity contributing to major post harvest losses. Agriculture production is usually done in areas far from urban/market centers (KARI, 2011). Poor roads make it difficult for potential buyers to access these areas and for the farmers to put fresh, competitive products on the market. Sending the mangoes to the markets become costly. The poor, bumpy roads makes the mangoes to finally reach the market when they are already in a deteriorating state and so fetch poor prices. The issue of poor roads is also used as an excuse by traders to offer poor prices for mangoes. The traders argue that they travel on bad roads from the farms to the market and when they finally reach the market, the mango quality would have deteriorated due to the bumpy roads. Therefore to bypass brokers and reduce transport costs to the market, farmers form groups. Collective marketing was the main reason for the formation of the Kanyuambora and Mururiri groups.

  However, even after forming groups for collective marketing, transportation costs in relation to market prices remain high for the farmers if they are to make some profits. This makes it difficult for farmers to send their products to the market as often as they would love to. Good road network is also essential as it enhances stakeholder participation into the groups. For example, in this mango case the groups with a better accessibility enjoyed receiving a lot of stakeholders helping them towards achieving their goals as is the case with the Kanyuambora group. The contextual features of Kanyuambora might have contributed to KARI Thika choosing Kanyuambora over Mururiri. This may be because the context of Kanyuambora makes it easier for KARI Thika to achieve its set project objectives. Kari Thika donated a deep freezer to Kanyuambora to use for storing sap and Mururiri group do not have electricity to operate fridges. KARI Thika worked with the Mururiri group but did not help with any equipment support. While working with Mururiri, KARI Thika helped the group with more knowledge on diversifying the product line and finally left Mururiri and worked with only Kanyuambora. On the contrary, Mbeere South has extremely bad roads and even though they are into mango processing like Kanyuambora, they have not had an opportunity to work with external stakeholders except for Ministry of Agriculture only. Poor roads also hinder the timely supply of the harvested farm produce on to the market.

- Market mechanisms and transactions: The farmers are not well tuned with marketing mechanisms. The farmers lack knowledge on market possibilities and alternatives. Farmers only know of selling their mangoes as raw or lately they came to know about processing. On their own they just grow mangoes naturally without any crop husbandry. However, the NGOs come to them with programmes encouraging them to enter into markets; an area where they do not understand the dynamics. The farmers do not have knowledge on pricing and agreements. They are used to the traditional way of farming which mainly operates basing on the moral economy. This is shown by the way they conduct their activities. For example, the Kareri Kwimenya group used to grow crops amongst themselves and sharing the yields basing on trusting each other and togetherness. However, when GTZ came they had to adopt a new way of maintaining relationships using signed contracts. The idea of contracts was completely new to them. The partnership held by the contract did not go down well with the farmers as they felt let down by GTZ after it did not pay them for the batch they had supplied. GTZ said they had supplied a bad product. In instances of misunderstanding with a buyer in lease agreements, the farmers lose out because they do not fully understand the mechanisms and regulations governing these types of marketing systems. The help of another external stakeholder is required under such circumstances.

- Another common challenge is the surplus of mango on the market during its season causing prices to drop. This is also compounded by the fact that farmers lack proper handling and packaging facilities at farm level. This makes the farmers to sell the mangoes soon after harvesting due to perishability of the fruit. Price negotiating becomes difficult and so farmers will sell to which ever buyer present. This makes the farmers to be manipulated as buyers become in charge of the process. Also because farmers lack proper handling facilities, they do not organize their mangoes according to grades in most cases. This makes it difficult for pricing and getting lucrative markets.

- Individual small holder output is generally low and usually the quality of mangoes is not constant. Markets require a constant supply of produce. During the production season, there is a glut which causes prices to drop. This limited produce quantities are channeled to the market through brokers and agents who usually offer poor prices. Individually, farmers find it difficult to supply mangoes in big quantities that can enable them to get into partnerships with leading market actors/organisations and to give them a stand to be able to lobby for prices (ICRA, 2010; KARI, 2011). Leading market actors/organisations make deals with farmers who can supply high quality produce in required quantities throughout the season at reasonable prices. This is a big challenge for small holder farmers to suit this criteria (Tschirley et al., 2010).

There are a lot of regimes operating against the farmers in the marketing area as discussed above. The farmers lack knowledge on how to get lucrative markets on their own as well as understanding the 'modern' way of doing business for example with the use of contracts. The

role of external stakeholders and institutions are of great importance in this case as they help in cushioning thus creating a niche to enable the farmers to understand dynamics before leaving them on their own.

4.2.4 Certification and export stage

In some instances, written down rules and formal regulations/procedures acts as barriers to market access in this case the certification and export process. The certification process for both domestic and export requires a level of understanding documentation and a certain level of literacy. Most of the farmers have difficulties in interpreting the documents and terminology used so it is difficult for them to understand the process. Actually in all cases of the farmer groups, they did not know about certification. It was external stakeholders who came to them with the knowledge on certification after mango processing as they tried to find favorable markets. It was also during the time when the farmers were selling their products for example in the Kanyuambora group where they sold their mango juice outside Kanyuambora business centre where the people know them. In outside communities, they are not known and so the people asked them for certification. That is how they became increasingly aware of it combined with the knowledge they were getting from Kari Thika which made them to understand why they needed certification the more. Another example of the farmers' limited knowledge on certification is the incidence of the Mbeere South group which came to know about certification after they had tried to sell their juice to some police officers. The police officers asked them about the certification mark which the farmers did not know about during that time. The farmers confessed that they really felt intimidated by the police remarks and so they sought more knowledge on certification from Ministry of Agriculture staff who had trained them on mango processing. Ministry of Agriculture then explained to the farmers the certification process and all it entails.

Besides the issue of the limited knowledge on what the certification process is and who does it, the farmers lack money which is needed by the KeBS authorities' inorder to analyze the samples from the farmers. Each product is pegged at a specific price. Wine is the product with the highest price for certification among the main products which the farmers make. Wine costs 32 000/- and juice costs 5 000/-. However, this is a large amount of money for the farmers to raise. Even after raising the 32 000/- for wine, the other challenge with wine is the packaging material. The rules and regulations governing wine are that wine should be packaged in bottles. However, the companies in Kenya which manufactures bottles for beverages do so on contracts with main players in the industry such as the Coca Cola company. Companies like Coca Cola own bottle moulds for the shapes of their drink containers. Therefore inorder for the farmers to get permission to use these shapes they should consult Coca Cola Company or come up with their own bottle moulds and shapes. However, both these two alternatives are expensive for the farmers. Another alternative left for bottling material for their wine is to import from countries such as Tanzania. However, this still remains an expensive alternative for the farmers. The Kanyuambora group which is at the most advanced stage towards certification has now

concentrated on certifying juice and concentrates even though wine also have a good market reception. This choice was affected by the regimes surrounding wine certification.

Farmers also struggle with coming up with the product quality and hygiene standards at their premises matching the certification standards. Inorder to get certified during laboratory analysis of product before certification, for example in the case of mango juice, the mango juice should not exceed a certain amount of sugar content and other things such as the amount of microbial activity inorder to be certified. However, this is difficult for mainly two of the groups because they do not have equipment needed to measure these aspects and have not been exposed to the knowledge of this unlike their counterparts (Mururiri and Kanyuambora groups). Also the Mbeere and Kareri Kwimenya groups do not have the basic building structure as is per requirement for certification when producing food for human consumption. However, for Mbeere South and Kareri Kwimenya to get their mango products certified, they need to get a building with running water and toilet facilities layered out at least in the basic form approved by KeBS. However, all these are challenges the farmer groups are facing inorder to get certification for their mango products.

Finally, even if the farmers manage to get certification and become market players, there are already big companies in the same business. The big companies already have a market share and they can offer competitive prices in the face of competition because they have the advantage of the economies of scale. It will be difficult for the small scale farmers to compete with these.

4.3 Discussions

Well structured markets for fresh and processed mango are important in improving the standard of live of small holder farmers in several ways. Firstly commercialization increases the average yield per unit area and so families become more food secure and have excess to sell. Also market structures increase opportunities for value addition of crops which provides farmers with employment opportunities thus an escape route from poverty(Tschirley et al., 2010).

4.3.1 The four mango cases and the Strategic Niche Management (SNM) approach

The prevailing regime operating in Kenya and Mbeere District forms the broader landscape in which the mango innovations need to fit inorder to become sustainable. However, this broad regime is characterized by a lot of factors, most of which are working against the new innovations.

The prevailing regimes in Kenya are more favorable towards the already established big commercial companies rather than the small scale farmers. For example in the production of mango wine, the bottle moulds which are used for bottling wine at the commercial scale are owned by major players in the beverage industry. The already financial constrained small scale farmers do not have money to pay the big companies so that they get permission to use the bottles. This have made the group that has progressed the most (Kanyuambora) to concentrate on getting certification for juice which is cheaper to certify and does not have string conditions on packaging material. The smallholder farmers still need to be cushioned until they can stand on their own. The prevailing regulatory regimes in Kenya demand certain standards which can only be met through having sufficient capital. The small scale farmers do not have capital to invest in knowledge and equipment. For example, inorder to have products certified, KeBS inspects the site and needs to see basic infrastructure in place that is a building with running water and toilets. The Mbeere South group has resource constraints which have been compounded by their geographical location. The group needs certification and is struggling to finish putting up a structure due to lack of capital. This is slowing the group's innovation pathway. The Mururiri group was fortunate to have a stakeholder (Arid lands) which helped in setting up their building even though their certification process is being delayed by lack of running water on their premises. The Kanyuambora group had an advantage of its setting along a busy road where there are business premises to rent with electricity and running water. Their setting enabled the group to move faster along the innovation path since the settings serves more like a reception for external stakeholders and most of the factors working against the other groups such as availability of electricity are working to their advantage.

However, through the strategic niche management, it shows that the innovations can be fruitful if given enough support as is the case with the Kanyuambora group which is almost at the stage of being given certification. Stakeholder participation in this case has been seen to be directly related to availability of new knowledge and resources for propelling the innovation forward as well as providing a niche. The group with the highest stakeholder support moves

faster along the innovation path and continuos to enjoy stakeholder recognition and support while the opposite is true for the group with the least number of stakeholders. The Kanyuambora group received several stakeholders at different stages of the process. These stakeholders helped the group to survive harsh conditions for example, helped the group to get knowledge in situations where knowledge was required (fine tuning skills for certification through help of Kari) and financial support (to acquire three phase electricity from Ministry of Gender). The contrary is the case with the Mbeere South group which almost received none external stakeholder support except for the Ministry of Agriculture. However, the Ministry of Agriculture could not provide capital in situations where capital was needed for constructing a building for mango processing and so this stalled the innovation path of the group. The other two groups (Mururiri and Kareri Kwimenya) portray an interesting characteristic on the working relationship with external stakeholders. A good working relationship with stakeholders propelled innovations forward as is the case with Mururiri group when they use the pasteurizer at ATDC when making a lot of juice. The opposite is true with Kareri Kwimenya when the relationship with GTZ turned sour and the group stopped mango processing. The four mango cases progress differently due to differences mainly on stakeholder participation.

There are gaps between institutional and organizational elements of the system which could be improved inorder to make the farmers' efforts yield results. For example, an improvement in infrastructure (roads, electricity) can make a significant impact in several ways along the mango value chain. It can ease market access; promote external stakeholder participation and knowledge interactions as well as upscale processing innovations. The Mururiri group was mainly affected by contextual features that it does not have electricity so the group failed to use all the technology it received in the form of processing equipment.

Other factors forming part of the broad regime include landscape features which entails poor infrastructure which determined the type of technologies to use, market accessibility and stakeholder participation. Infrastructural factors such as lack of electricity made the Mururiri group fail to operate the packaging equipment they received from the Arid lands project because the machines only operate on electricity**.** Also the role of external institutions such as the government if more funding streams for government activities could be made available inorder to avoid running half training schedules(as was the case with Mururiri).

In the mango case, l realized that the groups which received more support from external stakeholders especially during vulnerable stages of the innovation process performed much better and are an advanced stage in the innovation process compared to those who did not get any support. The success of the innovations to these small holder farmers is of great importance to them as a source of livelihood and if successful, other farmers with similar agro ecological conditions can get inspiration and follow suit.

4.3.3 Innovation systems approach

The innovation systems approach is of relevance in the mango case as there are interactions occurring among multiple actors around the mango innovation case in the context at a micro level in order to link the rural poor into value chains across local and global markets. Legislation is playing a pivotal role from different dimensions right from group formation until the stage of putting products on the mainstream mango market either for domestic market or for export. For domestic market, the issue of certification is playing a major role in propelling the innovation forward. For instance when farmers want to have their processed mango products certified. There are also institutional issues within the key Ministry of Agriculture in this mango case. Officers at the ministry's national office speak a different language with officials at the provincial and district levels. At the national level, they speak of partnering farmers with mango processing companies where as at the lower offices they are promoting farmers' innovations and to form industries themselves. This affects the creation of new policies favoring small holder innovations since this is usually undertaken at national level. Infrastructure in terms of roads and electricity in this case influences market accessibility, stakeholder participation in terms of donor agencies. Electricity influences the operation of machinery for processing.

However, the interaction these factors as described by the innovation systems approach forms part of the broader regime as described by the strategic niche management approach.

4.3.4 Knowledge Interactions

The knowledge interactions among the farmers' groups and the stakeholders have contributed much towards the results that have been witnessed in the Mango Case. The knowledge interactions among various stakeholders are important to propel innovations forward. The results can also be taken to mean that it is the combination of both scientific and local knowledges that is necessary for innovation success. Indigenous knowledge on its own cannot take innovations far. The most successful farmer group (Kanyuambora) is the one which interacted with the most number of external stakeholders. As well, farmers in all the groups, who received trainings on mango processing combined it with their traditional knowledge and came up with hybrids suiting the environments in which they live in. For example, through blending local and external knowledges, the farmers on their own came to know of dilution ratios (for indigenous varieties) when making mango juice and experimented to make sweet wine. Also the farmers extended the making of juice to other local fruits such as guavas and mandarins in order to suit their contexts.

In the mango case, scientific knowledge come to the farmers' mainly through extension services from government and through programs initiated by non- governmental organisations. In most cases, among the groups, it was these stake holders who initiated the mango processing innovations. The scientific knowledge coming in was in relation to every aspect of mango from production until marketing. In one instance, it was a government department into agricultural technology (ATDC) which came up with a machine to process mango which suit with the

prevailing conditions and situations of the farmers that they do not have electricity. So now with the machine and after been given the initial training to facilitate mango processing, the farmers adjusted and are still in the process of adjusting the scientific knowledge blending it with what they know and suit specifically their environments rather than just sticking to 'expert' knowledge. Even the officers who trained the farmers acknowledged their innovativeness and acknowledged that now they were at a point that they are learning from each other and not taking the farmers as passive recipients of technology.

The knowledge interactions resulted in a fusion between the scientific and local knowledges such that the result was a mixture of the two which could not be classified neither as scientific nor local knowledge. However, in some instances, a clear distinction exists between scientific and local knowledges. In some instances, scientific knowledge will take toll depending on what the interaction or innovation is about and in some instances, even after interactions, local knowledge will continue dominating on its own. For example, in terms of production, despite the farmers having been exposed to a lot of training based on the advantages of using chemical pesticides in terms of its effectiveness and enabling them to get an export market, they resisted spraying regimes mostly because chemicals are expensive to buy and still stuck to traditional practices such as burning tree branches even after exposure to information on spraying. They continue to innovate along the lines of traditional knowledge among themselves using locally available resources despite pressure to turn to chemical spraying regimes. This however has caused the Ministry to try and engage the farmers in coming up with a trap for the most troublesome pest – the mango fruit fly. The trap is less costly and user friendly.

The interactions between the knowledges and their effects are also influenced by different factors among the four groups such as age, gender, geographical location and stakeholder involvement.

4.3.5 Other discussions

Despite the success in becoming viable market players as witnessed in other innovation cases and in the promising groups discussed in this mango case, some scholars argue against the integration of smallholder farmers' innovations into modern commercial markets. These scholars argue that the farmers should be allowed to 'develop' along the structures which are not foreign to them and suits their knowledge and circumstances (Tschirley et al., 2010) argues that the traditional open air market have been a key player in marketing of fresh farm produce for small holder farmers for quite a long time. These types of markets continue to dominate in Sub Saharan Africa as 90% of the domestic produce is marketed through them even though the structured markets are continuosly increasing and being encouraged the more. Given the fact that 90% of fresh produce is marketed through these, improving efficiency of the traditional marketing system will increase income and raise the standard of life of the small holder rural farmers who are usually poverty stricken to the same level that market integration does. Therefore the best option to redeem the farmers from the challenges they face is not only through integrating them into the modern commercialized marketing system through

supermarket and industries since the farmers have limited knowledge and face a lot of challenges in trying to integrate into these as discussed above.

Also these initiatives of market integration are usually initiated by NGO's and public sector as projects running for a set time frame which usually is not enough time to alleviate the complexity of the challenges the farmers face in this quest. The best way therefore will be to support the farmers using the structures that they are used to and can comprehend (Tschirley et al., 2010).

5.0 References

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