UNIVERSITY OF COPENHAGEN AND
UNIVERSITY OF NAIROBI

Knowledge Flows Influencing Farming Practices in Weru-Muru, Kiambu County

INTERDISCIPLINARY LAND USE AND NATURAL RESOURCE MANAGEMENT

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0.1 Acknowledgements

This report is elaborated on the basis of a fieldwork conducted in the small farming community Weru-Muru, which is located 50 km northeast of Nairobi, Kenya. The fieldwork was undertaken in close collaboration with the two students from University of Nairobi: Sinoya Kevin Sitati and Kinyua Josphat Kiunga, we are so grateful to have been collaborating with you. We highly value your academic competencies that filled the natural scientific gap in our research group and it has been a pleasure to get to know you.

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And we are so grateful to the youth leader, Steve Nyutu, who has lost hours of sleep, school and work in order to guide us safe through the area, to appointments in the most distant parts of Weru-Muru. We cannot thank you enough for setting up interviews, translating until your mouth dried out and for just being constantly available throughout the fieldwork - we hope you have gotten more sleep since we left!

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Copenhagen, April 2015

Image 1: The agricultural research group (without Mille) together with the elders and the youth leader in front of the Anglican Church of Kenya in Weru-Muru

0.2 Abbreviations

AEO	Agricultural Extension Officer
FCI	Farm Concern International
KENVO	Kijabe Environmental Volunteers
KARI	Kenya Agricultural Research Institute
KALRO	Kenya Agriculture and Livestock Research Organisation[1]
MEO	Monitoring Evaluation Officer
MoA	Ministry of Agriculture
PoxC	Permanganate Oxidisable Carbon
P&Ds	Pests and Diseases
UoC	University of Copenhagen
UoN	University of Nairobi

0.3 Abstract

The Farm Management Handbook – published by the Kenyan Ministry of Agriculture – formed the basis of the development of our analytical framework for our fieldwork on agriculture in the village of Weru-Muru in Kenya. The Farm Management Handbook introduced us to the agricultural reality that traditional farming methods and practices are no longer capable of meeting today's demands but instead new scientific methods must be implemented. Though the knowledge of these methods is available in Kenya it is not available at farm level.

In this report we particularly decided to focus on the extent to which the flows of knowledge could be considered a constraint in improving farming practices in Weru-Muru. Following a theoretical outline we wished to identify discrete *types* of knowledge as well as different knowledge *flows*. We operationalised *knowledge types* in distinctions of endogenous and exogenous knowledge as well as tacit and codified knowledge.

From our main findings we could identify key endogenous sources including personal experiences, continuation of tradition, family and neighbours. The knowledge farmers obtain from these sources are dominantly tacit as it is based on experimental, unarticulated learning. Significant sources of codified knowledge were identified as mainly flowing from exogenous sources such as the Ministry of Agriculture and agrovets.

Concludingly, we argue that there is a significant difference between endo- and exogenous knowledge, both in the content of the knowledge, but also in how it is transferred and obtained, but that both are marred by lack of trust and access.

[1] Former KARI.

0.4 Division of chapters

The entire report has been elaborated in collaboration between all group members.

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1. Introduction

In the course Sustainable Land Use and Resource Management, in which the present paper has taken its departure, our first task was to choose a destination where we wanted to go on a three weeks vacation. This was a difficult task when choosing between as exotic destinations as Malaysia, Thailand, and Kenya.

We eventually decided upon Kenya for its famous Indian ocean beaches. Needless to say, the disappointment was devastating when we realized we were not going to the coast, but to the Central Highlands. The disappointment did not get any more tolerable when arriving to the small, primitive community, Weru-Muru, where flushing the toilet and showering with running hot water were concepts completely incoherent with reality.

So how do you then spend three weeks?

Well, being four inquisitive students from the University of Copenhagen, these descriptions are of course just as incoherent with reality as flushing toilets in Weru-Muru. In many aspects Kenya and Weru-Muru offered all the things that we could ask for from a fieldwork on agriculture - a topic that we had chosen before leaving to the field. The fieldwork and site provided an excellent combination of interesting historical, political and social dynamics, many instructive (and unforgettable) culture shocks, welcoming local inhabitants, kind and resourceful counterparts, and a beautiful natural environment to work in. In short, the three weeks in the field went much faster than we could ever have imagined.

1.1 Literature review

When we first started looking for research topics around agriculture in Kiambu County and particularly in Weru-Muru, we experienced some limitations with the literature on the topic. There was a good deal of literature on Kiambu county, but nothing on Weru-Muru - a place which we at that point were not even able to locate on a map. However, the Farm Management Handbook - published by the Kenyan Ministry of Agriculture in 2007 - gave us an impression of the resource richness of the Central Highlands and a useful overview of the agricultural activities and challenges in Kiambu County. Among the challenges a recurring issue seemed to be the limited accessibility of knowledge on new scientific farming methods at farm level (Hornetz et al.: 2007).

Together with our supervisors and with the information provided from the Handbook, we then developed a framework around this topic of agriculture and knowledge flows. Particularly, we decided to focus on the extent to which the flows of knowledge could be considered a constraint in improving farming practices in Weru-Muru.

During and after the fieldwork we started getting a better perspective on the relevance of our research in a wider context. Much research has been done on agriculture and knowledge flows in regards to the introduction of new *information and communications technology* (ICT) (Okello et al. 2010; Talwar et al. 2005; Kiplang'at & Ocholla 2005; Aker 2011). However, we have found very few studies related to the flows of knowledge occurring in farming communities where the exogenous knowledge sources are more present in the form of private, governmental and non-governmental institutions than as ICT services. However, a study that was made in Costa Rica on "*The role of personal information sources on the decision-making process of Costa Rican dairy farmers*" (Solano et al. 2003), helped us in the shaping of our research objective and in developing relevant questions for our interview guides. Additionally, the theoretical understanding of knowledge provided by Fredrik Barth (2002) made out a tool for categorising the field data both during and after the fieldwork.

With this in mind we started asking ourselves what the knowledge flows might look like in Weru-Muru. Which knowledge sources do the farmers rely on when making decisions regarding their farming practices? What are the constraints of the flows of knowledge. These thoughts combined with literature on colonialism and the paper *Indigenous Knowledge and Eurocentric Critiques of Development* by Raymond A. Morrow (2008), eventually led us to consider how the knowledge flows could either contribute to the Western model of development or reproduce the indigenous knowledge.

1.2 The site

The fieldwork was carried out in the village of Weru-Muru in Kiambu County about 50 km northeast of Nairobi. Kiambu County is the most densely populated county in the Central Province of Kenya. 70% of the population is engaged in cultivation of crops and the majority of farms are small-holdings, which form 90% of all farms in the county (Wabwoba et al. 2013).

The major cash crops cultivated in Kiambu County are coffee, tea, and pyrethrum. Maize (*Zea maize*) and beans (unspecified) are the most dominant food crops of the annual and bi-annual crops followed by Irish potatoes (*Solanum tuberosum*) and kales (*Brassica oleracea*). Banana (*Musa musaceae*) and avocado (*Persea americana*) dominate production of the perennial crops followed by fruit trees and oranges (unspecified) (Hornetz et al. 2007).

The county has a bimodal rainfall between March and May and in October and November with an annual rainfall above 1500 mm (Wabwoba et al. 2013). The altitude ranges from 1400m to 1800m above sea level (Hornetz et al.2007).

The village of Weru-Muru is located in Lari sub-county in the western part of Kiambu County. It borders the somewhat larger Kimende Township on the west side and is adjacent to Kereita Forest on the northeast side (see also image 2 for a map of Weru-Muru). The village population is predominantly Kikuyu and consists of about 2000 inhabitants and about 140 households according to the community leader.

According to the youth leader the name Weru-Muru means ‘bad soil’ and is derived from the previous natural conditions. The area used to be swampy and therefore the ubiquitous eucalyptus trees were planted to drain the area. The dark reddish brown soils are today well-drained. The dominant soils in the area are humic Nitosols, which normally are highly fertile caused by high content of minerals, soil water in addition to high *Cation Exchange Capacity* (CEC) (Hornetz et al. 2007).

A small stream runs through Weru-Muru and constitutes some of the boundary of the area and serves as water supply for some farmers living north of the main road. The village land is intensively utilised for agricultural cultivation and the same variety of crops are seen in most plots. The village area covers a sloping landscape divided into a low-laying part and an elevated part by the main junction.

Based on our literature review, information about the site and our theoretical framework we have arrived at the following objective:

With focus on the farmers of Weru-Muru in Kiambu County, this research aims to examine through which sources codified and tacit knowledge is acquired and how particular knowledge influences the farmers’ choice of crops as well as farming practices.

In order to achieve this stated objective, we have formulated a main research question and three sub-questions to guide us.

Main research question

How do knowledge flows regarding agriculture contribute to determining farmers' farming practices in Weru-Muru, Kiambu County?

Sub-questions

1. *How does the farmers' trust in knowledge sources influence their decisions regarding farming practices?*
2. *How is knowledge acquired and transferred through endogenous and exogenous sources?*
3. *Which types of knowledge influence the farmers' decisions regarding farming practices?*

1.4 Report structure

This report consists of 7 chapters. This preceding introduction describes our process of finding the objective through a literature review and research of the site before going into the field. We present our theoretical framework about knowledge types and flows in chapter 2. Then we go through our fieldwork process in chapter 3 and reflect on our applied methods. Chapter 4 deals with the presentation and analysis of our data relating them with sub-questions 1 and 2. Together with sub-question 3, these will also be addressed in the following discussion chapter. In chapter 6 we summarize our main findings from the two preceding chapters and state some concluding remarks and then we finalise the report with a chapter that includes a few new perspectives on knowledge in agriculture and opportunities for further research on this issue.

2. Theoretical framework

In this chapter we will account for and apply conceptual and theoretical frameworks of knowledge in order to put our empirical findings into a larger perspective.

An epistemological discussion of knowledge does not lie within the scope of this report, but in these paragraphs we wish to clarify our theoretical understanding of knowledge and its assimilation and distribution.

2.1 Knowledge types and flows

Following the theoretical outline of Fredrik Barth (2002) we wish to identify discrete *types* of knowledge as well as different knowledge *flows*. We will operationalise *knowledge types* in distinctions of endogenous and exogenous knowledge as well as tacit and codified knowledge.

We define *knowledge flows* as exchange, circulation and dissemination of knowledge within a specific setting and social structure. This builds on the model of knowledge provided by Barth (2002), who defines knowledge to be that which a person employs to interpret and act, and what provides people with a way to understand, think about and feel major aspects of the world (ibid.:1, 4). Thus his definition allows for encompassment of various different types of knowledge, such as information, feelings or attitudes, embodied skills, classifications, and concepts.

According to Barth knowledge has its wellsprings in individual experience, but is always intersubjectively deployed and hence becomes *conventional* in social circles and tends to be conservative and preserving of a given social order (ibid.:2). He proposes three interconnected faces of knowledge to be considered coherently, namely *corpus*, *medium*, and *social organisation*. Corpus is understood as individual or collective assertions and ideas about aspects of the world. The medium describes representations as words, symbols, actions, etc. Finally, social organisation regards the distribution, communication, employment, and transmission of knowledge within instituted social relations (ibid.:1, 3).

Our proposed concept of knowledge flows thus largely corresponds to the Barthian notions of corpus and medium, as we seek an understanding of how varying types of knowledge are spread within a social setting that it cannot be understood as foreign too. In this report we will apply these terms to the knowledge flows that we have identified through our data gathering in the field.

A key point of Barth's is that knowledge is mainly produced, changed, and circulated within instituted social relations rendering it *endogenous* in nature (ibid.:1, 10). Throughout this report we will follow analytical distinctions between endo- and exogenously generated or distributed knowledge. The main endogenous sources we will introduce are handed down skills, information acquired from peers, and farmers own experiences, whereas exogenous sources include the Ministry of Agriculture, agrovet shops, and NGOs (see section 4.2).

2.2 Tacit knowledge and trust

Our fieldwork is dealing primarily with local knowledge flows. However, in the report we are, as mentioned earlier, dealing with endogenous as well as exogenous knowledge sources and hence, the flows relate to that. These knowledge flows are determined by how they can be transferred. On a global scale, access to written knowledge sources and other medias have become easier through *Information and Communications Technology* (ICT). This has brought local knowledge to become advantageous as it is almost only transferrable on a local scale and therefore only includes those who are in spatial proximity of the knowledge source (Mackinnon and Cumbers 2007: 242, Dicken 2007: 100). This intangible and hard-to-transfer knowledge is also referred to as *tacit knowledge*.

Mackinnon and Cumbers (2007) define tacit knowledge in contrast to *codified knowledge* such as written and other formalised knowledge sources. Tacit knowledge refers to:

> "*direct experience and experience which is not communicable through written documents. It is a form of practical 'know-how' embodied in the skills and work practices of individuals and organisations.*" (Mackinnon and Cumbers 2007: 327).

This means that this type of knowledge can be characterised by being difficult to articulate, even for the person who possesses the knowledge.

We relate the concept of tacit knowledge to the farmers' *endogenous* knowledge flows and use it particularly to analyse the constraints in the exchange and dissemination of knowledge among farmers.

Barth argue that people extend the reach and scope of their knowledge by embracing the judgement of certain others, thus rendering the concept of *trust* vital (ibid.:2). Mackinnon and Cumbers concurringly describes that trust among actors is essential in order to ensure an unproblematic flow of knowledge between individuals or organisations (ibid.). They emphasise that the reputation of a knowledge source or the experience with collaborating with a certain actor, influences the trust held in them, meaning that a robust social network where the actors have frequent interaction, especially face-to-face, leads to an easier transference of tacit knowledge (ibid.).

3. Methods and methodology

This chapter provides an overview of the applied methods in the field as well as reflections on the context of these. This includes our academic, personal, and cultural adjustments in the field. This section also illuminates our research strategy from selection of informant types and general sampling to the choice of methods.

3.1 The good story of a fieldwork research

Gatekeepers and translation

Bob et al. (2005) explain that adapting to the field can be challenging, especially when living with local villagers and sharing their way of life. We do not understand neither Kikuyu nor Swahili and arrived at the field with very limited understandings of rural life in Kenya - but the adaptation was eased a great deal by our Kenyan counterparts who acted as cultural brokers.

The group was very heterogeneously constituted in terms of academic, cultural, and ethnical backgrounds. The University of Nairobi (UoN) had provided the Kenyan students of the group with quite different aims than we had been given by the University of Copenhagen (UoC), in that they focused specifically on identifying tangible problems and proposing solutions. Nevertheless, the group dynamics worked better than we could have hoped for. We utilised the synopsis that the UoC students had prepared beforehand as a basis of aligning expectations during the first days in the field, and reworked the research questions and interview guides collaboratively to also cover the data needs of the UoN students.

In short, the group was able to accommodate each other and fulfill what Bob et al. (2005) see as an insurance of a quality fieldwork:

> "*Academically, they must convince their counterparts that their knowledge, methods and approaches are valid and useful. Culturally, they must do so in a way which makes room for other people's opinions and perceptions, and avoid threatening or dominating them.*" (Bob et al. 2005: 60).

We were allocated a local interpreter, the youth leader, who seemingly is well-known and well-respected in the community. He served as a central gatekeeper, as he helped introduce us to most informants, as well as interpreting a number of interviews. Thus, he held a dual role as our assistant and interpreter as well as our *ethnographic informant* (Bujra 2006). As Bujra (2006) describes it, a local interpreter can become far more than a translator of language: they often become informant on social and cultural structures in the community and contribute to understanding interrelated behavioral dynamics (ibid.).

The youth leader was not trained in translating and therefore there were some obvious methodological downfalls with this. Generally, the flow of interpreted interviews were disruptive,which is difficult to avoid no matter how skillful the interpreter may be.

As Bujra (2006) also notes:

> "*The problem with dependence on local translators is that one can be restricted and trapped within their perspective on their own society*" (Bujra, 2006, pp. 174).

We have to keep in mind that our translators positionality influences the interviewees and in addition he also has his own personal perceptions of the community that might influence his understanding of the responses the interviewees give. We tried to cope with this by emphasising methodological importance of exact and rigorous translation, which seemed to rectify the problem some. Still, we preferred to carry out the interviews in Swahili or English when possible, with translation carried out by our Kenyan counterparts, with whom we shared a deeper common understanding of the objective of the research.

As we gained interview experience we also achieved a familiarity with the interview guides, giving us independence from the papers. It became easier to ask relevant follow-up and prompting questions and to rephrase or change the order of the questions when it felt natural in the situation. Furthermore, it became easier to take control over the interview situation and guide our translator according to our methodological wishes. Avoiding boring the interviewee and wasting the farmers often valuable time was, thus, important for both the well-being of the interviewee and for the reliability of our data.

Positioning

Arriving as unfamiliar faces to a small and foreign community is bound stir up expectations[2] - both negative and positive. These expectations were in part leveled by the two community elders informing the community about us, and by accompanying us to most farmer interviews.

We were told not to contact community members without either the elders or the youth leader being present. This might also have influenced the answers from the farmers, depending on their opinion of these local authorities and their trust in them. The interviewees might have been skeptical and withheld information, since some information could be considered sensitive to pass on to a youth leader who is in close contact with the elders. We worried that some of the farmers would be reluctant to tell us which knowledge sources they relied on the most as the answer might be controversial or disliked by our gatekeepers. The same holds true for the answers regarding the use of fertiliser and the amounts and frequency of application. In the same way, we wondered whether the answers on knowledge sharing and organisation of farmers would only be positive, as that might be what the elders would want to hear. We often found it necessary to explicit our positionality as students, and not NGO workers or government officials intending to return with follow-up projects to improve soils or provide handouts. This appeared to come as a surprise to many farmers, especially the men, who would tell us stories of water and land scarcity and then present their needs to us.

3.2 Reflecting on the applied methods

During the first days in the field we went for walks along the perimeter of Weru-Muru, led by the youth leader, to get an overview of the scale of the area. On this walk, we were able to observe which crops were grown in the area as well as the extent of livestock, fruit trees, irrigation etc. We tracked this walk until the GPS ran out of battery, after which we used a smartphone to get the coordinates. Afterwards we added the coordinates, *tracks* and *waypoints* (Garmin 2005) to ©Google Earth so as to create a map showing our exact research area (see image 2 below).

[2] Particularly as some of us clearly stood out because of skin colour.

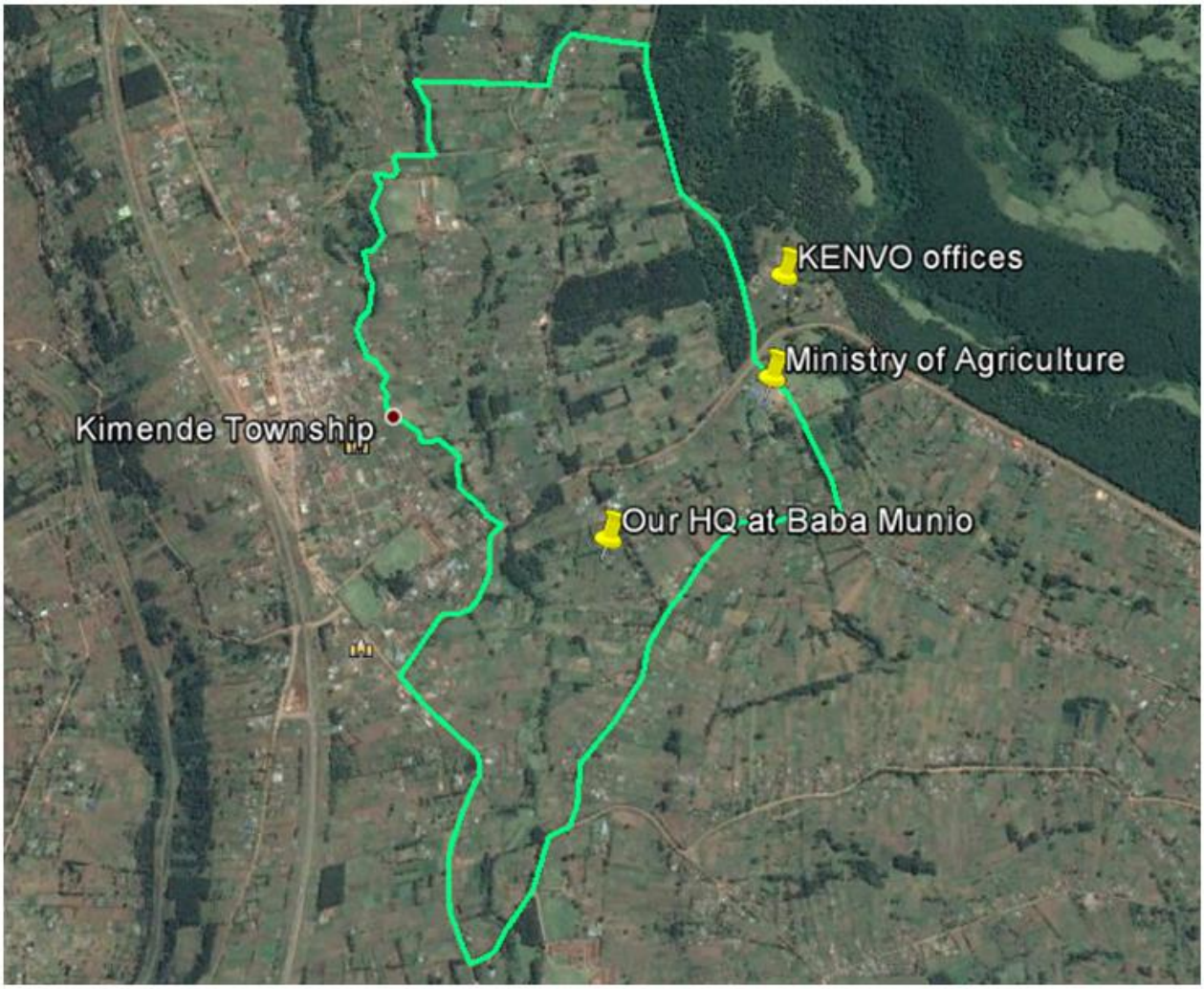

Image 2: The boundaries of Weru-Muru shown from an altitude of 6,7 km above ground (Weru-Muru is 2391 m above sea level). Source: © Google 2014.

Image 3: A map of Kenya showing the location of Weru-Muru. Source: © Google 2014.

Before going to the field we prepared a sampling strategy wherein we discussed who would be the most appropriate and relevant informants regarding agricultural practices (cf. Appendix I: Synopsis). In this we focused on the people primarily responsible for farming, rather than following discrete markers such as gender or age.

In our synopsis we defined our sampling strategy regarding which households to visit, as the following:

> "*Depending on the landscape, we have (...) decided to make a preliminary path through the village visiting every X household on the way*" (ibid.).

However, due to miscommunications our sampling was prepared by the elders and literally out of our hands. We were provided with a list of 30 households, of which 25 were small-scale and 5 were large-scale. We considered possible biases, such as an imaginable interest of the elders to mainly include wealthier households, but these speculations declined throughout the fieldwork. However, it is not possible for us to meaningfully assess whether the farmers we interviewed were representative when it comes to income level and other factors. We were able to assess the geographical dispersion of interviews and monitor that we were covering the village considerately in regards to proximity to knowledge sources and geographical characteristics. This dispersion would also ensure that we covered the farmers' perception of the soil fertility geographically and this knowledge could then later on be used for triangulation with the results from the soil samples.

We chose the *semi-structured interview* (SSI) as the primary methodological tool to gather information from farmers and key informants[3]. Apart from the value of questions that are not inclining the interviewee towards a rigid answer, the method allowed us to better engage in the conversation as semi-structured questions could be complemented by in-depth and follow-up questions.

The majority of interviews took place in a relaxed atmosphere such as the farmers' house or on the farmers' land, and was conducted by two members of our group.

Before starting the process of interviewing farmers we pre-tested our interview guide on one farmer to clarify if it contained any inappropriate, impolite, or confusing questions. At that time we concluded that it was not the case and that only minor adjustments were needed. During the interview process it did become clear to us that we had to make larger adjustments, either because the questions encouraged the respondents to talk negatively about someone or because it was difficult to answer. Hence a question like *'Who do you rely more/less on?'* was converted into *'Who gives the best advice?'*.

In the beginning of the interview process reluctance from interviewees caused some frustration. We realised that a way to loosen up the rigid interview situation was to take a walk among the crops, asking crop-related questions. Additionally, this gave us a natural gateway to make observations while talking and triangulating these with their responses.

The SSI method was used to obtain both quantitative and qualitative data and allowed us to explore a field about which we had almost no site-specific background knowledge from the literature review. In this way the answers from the SSI shaped the questions that again shaped the answers that could later be both interpreted and somewhat quantified.

[3] Understood as individuals who have special knowledge on a certain topic (Mikkelsen 2005).

The interview guide we used for farmers' SSI also served as an outline for most key-informant interviews, as we sought to be able to directly compare answers, triangulate, from these key actors and the farmers.

We started the process of condensing the raw data - what was actually said during the interview – into relatively short notes after most interviews. To analyse the qualitative raw data, we constructed a matrix display (Mikkelsen 2005; Appendix IV). This matrix was filled out continuously throughout the interview process to get an overview of the raw data and start identifying patterns. This process of analysis already started after the first interviews were conducted and continued as the fieldwork progressed.

As a way of assessing the farmers' knowledge sources and types, we asked them about their perceptions of soil fertility, whether it changed within their plot of land and whether it had changed over a period of time. We received very varied answers regarding the change in soil fertility as we had not fixed a period of time. After some of the interviews we asked to take soil samples from the fields of the farmer, following the two methods described in table 1.

Bulk density method	**For C:N ratio and PoxC** (available carbon in the soil)
We used the volume specific 100 cm3 iron rings to disturb the soil as little as possible and thus create high validity of the samples.	We dug three holes near the homestead and with the same amount of soil from each hole we got a representative average of the soil near the homestead. We applied the same method for the soil sample further away from the homestead. One of the supervisors from UoN advised us to do it like this to not get any errors related to recent use of manure, fertiliser, watering or other, on the specific place that we would take the soil sample.

Table 1: The two applied methods of sampling soil in the field.

The soil samples were dried as soon as possible after having being dug up from the ground in order to halt any biological transformations (Anderson and Ingram: 1993).

To further triangulate our data, two group exercises were conducted. We used the *Participatory Rural Appraisal* (PRA) method, which is a rapid and useful tool to systematically describe and analyse a community (Selener et al.: 1999) and in addition the dynamics of a group situation can provide additional important information (Mikkelsen: 2005) to individual time-consuming interviews. As men seemed to dominate the interview situation when both men and women were present during the SSI, men and women were grouped separately in order not to let gender roles influence the outcome of the exercises. We used the PRA method to sketch a cultural map identifying what the participants grow on their land and where they go for advice. This was followed by an individual knowledge ranking.

We started out by drawing a map of Weru-Muru on a sheet of paper accompanied by the elder and then asked the farmers to draw their plot on the map (cf. Appendix V). It turned out that all participants in both groups lived very close to one another. This initially weakened the exercise since we knew that neighbors share knowledge and therefore the outcome of the exercise would not be representative of our research area. The farmers were then asked to name all the crops they grow and subsequently add them to the drawing. Followingly, they were asked where they went for

information on farming practices. We then added the listed responses to the map. In addition, the farmers were asked to draw lines with arrows to illustrate where they went for information. The exercises ended with each farmer ranking their knowledge sources on a sheet of paper based on who gives the best advice.

Image 4: PRA session with the men's group. Sitati in the background and (on his right side) the elder interpreting to Kikuyu.

Trying out new methods in the field can require flexibility and fast thinking. The following example from the women's PRA group definitely forced us to be quick on our feet.

The female group started out a bit chaotic as 14 women, a few children and an old man showed up. We had initially asked the elders for 3-5 participants in each group. The situation did not become less chaotic as it turned out that everybody wanted to participate and some women kept asking for permission to draw on the map even after 5 participants were chosen and the exercise had started. The daughter of the host sometimes took over the role of translating, leading us to lose some control over the situation (cf. Bujra 2006). On the other hand it was also a great help as it was a difficult and confusing task for the Kenyan student to translate what everybody said.

The apparent strength of this exercise was that the plenary discussions helped the participants to remember knowledge sources and create awareness of the influence of each of the sources. On the other hand a weakness of the exercise could very likely be that the participants were influenced by responses from other participants which could affect their answers, e.g. what is the correct answer to a question. In addition we assume, as with the presence of the youth leader in interview situations, that the large number of people present in the female group and the presence of the elder in the male group could make the participants feel exposed.

In addition to these methods, we have gathered information through informal talks throughout the entire fieldwork. The informal talks have included almost everyone from the community leaders to

people met on our way walking through the village to our host families. This way of gathering information has contributed significantly to our understanding of the community and to keep improving our interview guides. Each group member has in parallel kept a field diary during our stay in the field, consisting of personal notes as well as academic considerations. The field diaries have been valuable in the post-field reconstruction of the fieldwork process, daily schedules, constraints, and observations.

4. Data presentation and analysis

Our fieldwork has been revolving around gathering data in order to answer our main research question as well as our three sub-questions. In this chapter we present these empirical data in three sections. The first section includes a synthesis of the data gathered related to the farmers' motivations behind decision-making about agricultural practices. Section 4.2 presents the knowledge sources mentioned by the farmers and analyse their respective roles in disseminating, exchanging and circulating knowledge. In the last section we present and analyse the knowledge flows and the constraining factors of these, especially regarding exchange of knowledge.

We have chosen to extract data from all our fieldwork including SSIs, informal talks and walks, PRA sessions and observations and are throughout this chapter presenting selected data in a quantitative manner through tables. These tables are then used as point of departure for our analysis by presenting selected qualitative data in order to support or contest the data.

4.1 Agricultural practices and constraints

In this section we will examine the motives behind the farmers' choice of crops and farming practices by looking at the prevalence of crops grown and applied practices. This will also give us an idea of the farmers' degree of trust in the knowledge sources and of their accessibility to different knowledge sources that potentially change the farmers' farming practices.

4.1.1 Choice of crops and farming practices

In Weru-Muru the predominant way of farming is horticultural. The land is often fragmented in small plots for each crop and with relatively high diversification of crops (see image 5). An estimated average of 50% of the production is for subsistence (cf. Appendix IV) and only a few of the crops are grown at a larger scale and sold in bulk on the market through middlemen. Some other minor crops are also sold on local markets, although almost exclusively in small quantities by individual farmers (Stein: 2015).

Image 5: A plot in Weru-Muru, napier grass (Pennisetum purpureum) in the front, spinach and potatoes further down and kale production just before the tree cluster.

Looking at table 2 we can ask ourselves how come maize, kale, and potato are grown more extensively than courgette, bean and spinach? And why do the farmers even bother to grow black nightshade?

Based on the farmers' interviews we understood that the farmers mainly prioritise the marketability of the crops. Particularly potatoes, kale, and carrots seem to have a high value, according to the farmers.

A main factor seems to be grow rates: All of the crops are considered fast-growing, with maize being the sole exception with a growing time of 9-12 months compared to around 3 months for the rest. Replies about why maize was prioritised were often vague, with its use as fodder for cattle being the perhaps most tangible answer. Other farmers cite that their neighbours and parents did so, when posed this question or even that a passed-on "*traditional farming calendar*" prescribed them to do so (Hjorth: 2015).

Crops grown by farmers[4] in Weru-Muru

Crop	*How many farmers grow this crop? (Interviews)*	*How many farmers grow this crop? (PRA)*	*What do the farmers consider the most important crop(s)? (Interviews)*

[4] n=20 (interviews); n=9 (PRA in two groups of 4 males and 5 females).

Maize	18	4+	4
Kale	17	2+	9
Potato	17	4+	12
Carrot (Daucus carota)	13		6
Cabbage (Brassica oleracea)	12		4
Bean (Unspecified)	9	1+	1
Spinach (Spinacia oleracea)	9		
Coriander (Coriandrum sativum)	6		1
Courgette (Cucurbita pepo)	5		
Black nightshade (Solanum nigrum)	2		
Napier grass (Pennisetum purpureum)		2+	
Pea (Pisum sativum)	1		1

Table 2: Overview of the most common crops in Weru-Muru and the frequency with which they are grown. The words in brackets refer to the data collection technique.

Should it then be considered a type of tacit knowledge from an endogenous knowledge source that was never really actively reflected upon by the present generations? If this is the case, it may not even be fair to assume that the farmers are prioritising food security and poverty reduction in the way that the MoA is. If culture and tradition is the main reason, then decreasing the production of maize may have a more sensitive side to it (Ehn & Löfgren 2006).

Another example of tacit knowledge is the crop rotation system. In a few cases the reason for rotating was explained with the fact that nutrients would be depleted if they keep on growing the same crop the same place (which makes sense from a natural science perspective). However, the great majority of interviewed farmers was not able to explain why they did this, except for that they always had been doing so. Furthermore we observed that some were rotating crops that require the same soil nutrients which then defeats the purpose of crop rotation.

In contrast to the maize and crop rotation is the farmyard manure[5] which to a large extent has been successfully adopted by the farmers in Weru-Muru during recent years. According to one of our informants, this technique was taught to 33 farmers that attended *Farm Forums* that take place in Weru-Muru 3-4 times a year and which, in contrast to most other sources of knowledge, are organised by the farmers themselves. At these forums one or more experts from institutions such as MoA, KALRO, or KENVO are invited to share their experiences with the farmers. The forum seems like a tradition that all attendants were quite positive towards.

Hence, we argue that some exogenous knowledge about farming penetrates the border between farmers and the official institutions more easily than other. Interventions such as the farmyard manure technique that do not require the farmers to challenge traditional cultural patterns, flow more freely. Furthermore, the direct contact with the formal sources of knowledge seems to encourage the farmers to adopt new farming practices.

On one side we wondered how this practice succeeded in being accepted by the farming community, but on the other side we were equally puzzled by the reason for adding chemical waste products to the burning process of the ashes which was observed on several occasions. Many farmers seemed almost completely careless about what went into the burning process - as long as there were ashes for the farmyard. It was difficult for us to believe that an expert from the MoA or KALRO[6] had taught them this, even though environmental issues are not a top priority of the MoA. Unfortunately, we never got an answer to the question.

Concerning the crops that have been around for generations it seem there is very little willingness to change. However, a good deal of the farmers seem to be open to trying new crops, as long as they do not compromise the production of the main crops - courgette, black nightshade, and coriander are among the recently introduced crops. When we looked into whether anything characterised these venturous farmers, we found out that most of them have a higher education level than the average, and that they are generally relatively young. These were generally also the farmers with most different sources of knowledge.

4.1.2 Constraints and knowledge sources

In our interviews we asked the farming responsible about the main challenges related to their agricultural practices. The responses from the farmers can help us answer our sub-questions and thus achieve the ocjective of report.

The data in table 3 helps us in determining which knowledge sources the farmers trust more as we have asked them where they go for advice with a specific problem and who provides the best advice.

Constraints related to farming[7]

Constraints (PRA & interviews)	*How many farmers mention this? (Interviews)*	*Where do farmers mostly go for advice when encountering this challenge? (1. being the most common place)*

[5] A technique where ashes, manure and green manure are mixed in a composting system and then added to the fields for increasing soil fertility.

[6] The farmers were not exactly sure where the expert came from.

[7] n=20 (interviews); n=9 (PRA in two groups of 4 males and 5 females).

		(PRA & interviews)
Pest	10	1. Agrovets, 2. MoA, 3. Field Days
Disease	9	1. Agrovets, 2. KALRO, 3. Field Days
Drought/water scarcity	9	1. MoA, 2. Agrovets
Frostbite	4	1. Agrovets, 2. MoA
Soil fertility	2	
Lack of technology	2	1. MoA, 2. Farm Forums,
Waterlogging	1	

Table 3: Prevalence of constraints in farming and an overview of where the farmers seek advice on these particular constraints.

Many farmers have indicated challenges with P&Ds, particularly related to maize. Farmers almost exclusively go to the agrovets and MoA when encountering these challenges, and mainly to the agrovets. This gives these actors a potential privilege in regards to the control of disseminating knowledge to the farmers. However, this is particularly related to P&Ds, and in particular to the application of chemical fertilisers and pesticides. In other aspects, such as water scarcity and lack of technology the MoA or other actors seem to have the same or even more contact with the farmers. This also means that some farmers would always seek advice from the agrovets, while some, though hardly any, other farmers would tend to avoid these.

Looking deeper into the agricultural constraints presented in table 3, we see patterns related to the knowledge that is disseminated, exchanged and circulated in Weru-Muru. The different types of knowledge along with the farmers' degree of trust in different knowledge sources determine how knowledge flows and thereby to what extent farming practices may change.

4.1.3 Soil fertility

Common sense could be regarded as a source of knowledge and therefore we decided to ask the farmers about their assessment of soil fertility. It could be argued that they 'read' the agricultural landscape in order to assess the soil fertility and the health of their crops.

Farmers' assessments of soil fertility

Soil fertility on land	*Number of farmers*
Good	7
Average	6
Poor	3

Table 4: Farmers' assessment of soil fertility. The categorisations 'good', 'average', and 'poor' have been applied after analysing the responses from the farming responsibles.

As table 4 shows, the soil fertility was assessed slightly above average. The farmers often based it on how the crops seemed to be doing and how they yielded. A few farmers also looked at the colour of the soil, red being the poorer and dark being the better. A few farmers had a more detailed descriptions of which parts of their plot were more fertile than others. In one case this was explained by the proximity to the homestead; manure from the livestock was hard work and was therefore applied more generously closer to the homestead.

We also asked them how fertility has changed over a period of time, though never defined the time span. Therefore, the answers we got were very varied. Some who related their answers to a time period of 40 years, replied that soil fertility had improved because the planting of eucalyptus trees, while most of the replies, that related to a 2-3 years time period, said that soil fertility had dropped based on the decrease in their crop yields (cf. appendix IV). Almost everyone denoted manure as a way of keeping or increasing the soil fertility (ibid.).

Farmers' choice of fertiliser

Types of fertiliser added	*Number of farmers*
Manure	18
Chemical fertiliser	14
Farmyard manure	4
Green manure	1

Table 5: The fertilisers are ranked by frequency of use. If two or more types of fertiliser are mentioned, they will both get a point.

As shown in table 5 fertilisers were highly used. When assessing soil fertility, the assessment generally seemed to be highly related to the availability and application of fertilisers, primarily manure. Two farmers indicated that they perceive manure as better for soil pH than chemical fertilisers and a few farmers indicated that manure is for the soil and chemical fertiliser is for the plants.

A few farmers emphasised that they do not use chemical fertilisers or that they only apply it to a limited extent. They gave us answers such as that the chemical fertiliser hardens the soil, whereas manure is long lasting and "spreads" the soil (creating air channels and thus decreasing the bulk density); that manure is the best to apply because it does not destroy the soil structure and soil particles or that chemical fertiliser increases soil acidity (cf. to appendix IV). However, other farmers were less critical to the application of chemical fertilisers, and were rather troubled by the lack of economic capital to buy it.

Table 6 shows our own results from the soil analyses done in the laboratory. We have only included the mean values from each test (cf. Appendix VI). As a way of addressing our sub-questions we wish to investigate how the the farmers' knowledge on soil fertility correspond with the lab results.

Soil fertility results

Soil sampling test	*Results in average from 10 samples on 5 farms*
pH	6,4
PoxC (Available mg carbon per kg soil)	936
Bulk density g/cm^3	0,75475
C/N ratio	10/1

Table 6: Laboratory results on soil fertility.

The pH levels in Weru-Muru are close to neutral (7), which indicates a healthy soil (FAO 2006). This involves that the most important nutrients are available and we do not consider soil acidity a problem. However, the samples were taken at the end of the dry season. Rainfall will cause leaching of nutrients and lower the pH level. That said, only two farmers of relatively high education have insinuated that soil acidity has been a problem (cf. appendix IV).

The use of many types of chemical fertilisers is known to increase soil acidity (ibid.). When a few farmers then claim that they try to limit the use of chemical fertilisers with the argument that acidity is a problem, we get the impression that this knowledge at least has flowed into the farming community from exogenous sources. Inversely, the urea and ammonium found in manure work respectively as a basic and acidic buffer in the soil (pers. comm. Catherine Hepp). The fact that the manure is preferred by many farmers could however both be attributed to passed on experiences from earlier generations (endogenous) or from exogenous knowledge sources.

To calculate the PoxC[8] results from the laboratory, we used the following equation which gives the available carbon in milligram per kilogram soil:

$$(mg/kg) = (0,02-[Abs])*9000*(0,02/0,0025)$$

The results from the samples all show a good soil fertility in regards to available carbon content. High available carbon content accelerates the metabolism of the soil life and hence more nutrients are released into the soil for the plants to grow (ibid.).

Also the C/N ratio results indicate that much nitrogen is available for the plants to grow. An optimal C/N ratio for most plant growth lies around 25/1, which makes these soils slightly low in carbon, but apparently not in available carbon (FAO 2006). Hence, carbon and nitrogen do not seem to be limiting factors for the soil. However, since the samples were taken at the end of the rainy season, the risk of nutrient leaching has not been present for some time. Anyway, many farmers commented on the large amounts of manure that are required to maintain the soil fertile, and three mentioned leaching related to rainfall as the problem. We would then expect this to be an even bigger problem during the rainy seasons.

[8] Permanganate Oxidisable Carbon; refers to the agent permanganate, which is used to analyse how much carbon is in the soil.

The PoxC and C/N ratio results compared with the farmers' statements give us the impression that the soils generally are quite fertile.

According to our samples, the bulk density in the area is very low. This may in part be because the samples were taken from the upper layer of the soil where compaction is generally lower. However, in a physical analysis made from the same samples we identified the soil as a silty loam. This supports the results of the bulk density. The low bulk density indicates that it has a relatively high water holding capacity and infiltration rate and that the plants root growth is not restricted (Lewis and Lowenfels: 2010).

The data has been limiting in identifying farmers' terminology that points conclusively in a direction in regards to the sources of knowledge. This inadequacy makes it difficult to say anything conclusive of how much of their knowledge reasonably could be categorised as exogenous and endogenous knowledge respectively. In many cases the data can only support the claim that farmers in Weru-Muru have an assessment of the soil fertility in relation to crop production that is shared by natural science results, but not where they have the knowledge from.

However, we would argue that the technical terms, such as 'soil acidity', 'waterlogging', 'leaching', only are used in a few cases and mostly by the more educated farmers, while the less educated farmers mostly use descriptions, such as the colour of the soil (e.g. dark or red) and the crops (e.g. greenness of the kale) that are related to experiential learning and 'readings' of the landscape. The differences in terminology, then, leads us to believe that the former is more related to exogenous knowledge sources and the latter more to endogenous sources.

4. 2 Sources of Knowledge

This section provides an introduction to the knowledge sources that the farmers in Weru-Muru make use of. These sources are divided into exogenous and endogenous sources and the latter includes experiential knowledge. The data on knowledge sources are mostly based on interviews and the PRA sessions. It is an attempt to examine which actors the farmers know of and have access to in order to analyse the constraints in the endogenous and exogenous knowledge flows respectively.

Table 7 below gives an overview of the knowledge sources mentioned by farmers in Weru-Muru. The selected data in the table is based on data from SSIs and the PRA sessions. In this part, we will mainly deal with the knowledge sources we found to be more general and used by several of our respondents.

The farmers' use of knowledge sources

Knowledge sources (mentioned by informants)	*How many farmers use the knowledge source (Interviews)*	*How many farmers use the knowledge source (PRA)*	*How many farmers consider the source to be the most trustworthy (Interviews)*	*How many farmers place this source among the two highest*	*How many farmers place this source among the two lowest*

				rated (PRA)	*rated (PRA)*
Agrovets	12	9	4	8	1
Radio shows	8	9		3	1
Neighbours	6	9	1	3	4
TV	6	9		3	3
MoA	5	5	2	1	1
Field Days	3	2		1	1
KENVO	3		1		
Family	3				
Other farmers	3		1		
Friends	3	5	2		1
KARI/KALRO	2	4			1
Written information	2				
Farm Forum	2				
Community meeting		5			5
Non-pertinent sources (n=1): International trade fair, Market (prices), Internet, Own experience, NGOs (general), FCI (Farm Concern International)					

Table 7: Overview of the knowledge sources utilised by the farmers. The numbers refer to the number of farmers and the words in brackets refer to the data collection method.

In table 7 we see that the agrovets have the highest amount of farmers' appointing it as a knowledge source they use and 12 farmers (see column 4+5) have appointed it as the most trustworthy one. That notion is supported by only 1 farmer (with a long education) appointing agrovets as the least trustworthy source of knowledge. 8 farmers mention that they depend on radio shows as their knowledge source. In general the data show us that the more a source is utilised by the farmers, the higher the degree of trust also seems to be.

4.2.1 The Ministry of Agriculture

The offices of the Kenyan Ministry of Agriculture (MoA) in the Lari sub-county are located within Weru-Muru (see image 2 for a map). Locally, their main task is agricultural extension services, understood as outreach and training of farmers in agricultural methods and practices. The main objectives of the MoA extension effort, as described by the local MEO, are raising food security and elevate income to battle poverty. This is attempted through supervision and intervention, largely through local gatherings, *barazas*[9], Field Days and Farm Forums, wherein extension officers and other agents arrange public hands-on training in the villages. The agents with whom the MoA cooperates in arranging Field Days vary from local NGOs to multinational chemical companies.

From our interviews, conversations and general presence in Weru-Muru, we gather that only few farmers use the extension sector to acquire or verify knowledge, and that a majority of the farmers we interviewed do not consider it a significant potential knowledge source. Many farmers voice aggression towards the ministry and frustrations about not being heard by the AEOs. Some made claims such as that the MoA had "*never done anything for me*" or that "*the extensions sector is asleep*", and some even gave accounts of being caught up in bureaucratic loops and facing extortion:

> "*when I went to the* [local] *office, they sent me to another place and then another place. (...) I ended up in the Limuru office where they told me they needed 5000 shillings for gasoline just to come and visit me. 5000 shillings! They're right down the road. (...) I will never go to the extension officer for advice*" Mishek Kere, Weru-Muru farmer (Stein: 2015)

Some community members with more positive inclinations towards the MoA argued that many farmers feel animosity towards the MoA based on frustrations from old regimes, such as under the dictatorship of Daniel Moi, and that extension services have undergone significant improvement since. Additionally, most community members felt that the MoA failed to uphold a presence in the area and called for the extension sector to actively initiate contact with the farmers. Thus it was a general sentiment among the MoA as well as our interviewees that the other party ought to actively come to them.

Despite the overall negative or hesitant sentiments about pursuing advice or support through ministerial extension services the MoA is generally regarded as a trustworthy source of knowledge by the farmers. Rather it is questions of access and perceived means of entry that seem to hinder interaction between farmers and extension officers.

4.2.2 Agrovets

Agrovets are grocers of seeds, chemical fertilisers, herbi- and pesticides and other farming-related products. For farmers in Weru-Muru the available agrovets are around 15 small shops in the nearby township of Kimende. Apart from buying seeds and chemicals the farmers also utilise these shops as a kind of knowledge centre, getting advice and sharing experiences with the staff and other customers. The advice mainly revolves around the application of chemical fertilisers, and about livestock rearing.

The gravity of the agrovets importance is emphasised by the fact that they are often invited for or involved in the arrangement of the Field Days organised by the MoA. The agrovet employees

[9] Public meetings including local leaders.

themselves in turn are trained by the chemical companies whose products they are selling, but also claim to stay updated on the results and progress of customers. Critical opinions of the agrovets were usually only heard from higher educated and resourceful community members. These individuals often spoke of the knowledge distributed by agrovets as short-sighted, shallow, business-centered, and untrustworthy (ibid.).

The agrovet vendors we talked to expressed strong antipathy towards the MoA who they, among other things, accused of being lazy, old-fashioned, ineffective, and arrogant. Or as one storekeeper laughingly puts it:

> "*The agricultural sector has failed. I'm the extension officer now*" Agrovet employee in Kimende (Stein: 2015)

Albeit the context for this excerpt was a casual and humourous one, it holds some hard truth as agrovets indeed is the majority of the farmers' knowledge source of choice regarding most of the subjects which the MoA extension sector is aiming at.

Image 6: One of many agrovet stores in Kimende Township utilised by the farmers of Weru-Muru.

4.2.3 Neighbours, friends and family

When asked about whether they share knowledge with others, farmers' replies were very mixed: some actively engage in knowledge exchange with neighbours, friends, and family, while others

declare they do not do it at all. During informal talks some interviewees mentioned that they had little trust in the advice they got from their neighbours and that they consider competitive downfalls in sharing good farming practices with neighbours, as they cater to the same markets. Some even told us that their neighbours give them deliberately wrong advice to harm them and to promote their own competitive advantages.

One farmer mentioned during an interview that he has encouraged other farmers to come by and learn from him. After the interview the community leader assessed that he only said that to please us, the interviewers, but that his words were not rooted in reality if farmers showed up at his doorstep willing to learn. The same assessment came from one of the host families, who did not know this farmer, when they were told about this encouragement. Some interview answers and the assessment of the farmer in question indicate that a lack of trust is rooted within the community when it comes to exchanging knowledge on farming practices.The case is not quite the same for knowledge sharing among family and friends. Several farmers told us that they receive good advice from friends and visit their friends when they are in need of farming advice.

4.1.4 Radio, TV and written media

Almost all our interviewees referred to the radio as a specific source of knowledge on farming practices. Many farmers told us that they listen to the radio in general and from our own observation we can also note that many farmers have a radio and it is often turned on when entering a farmers house. Particularly the local radio show *The Voice of the Farmer* (Kikuyu: Wasya wa Muimi) was mentioned by several respondents. It initially started out as a pilot-project responding to the fact that many local coping strategies regarding variable seasonal rainfall no longer occur reliable to guarantee food security. The radio show was developed in cooperation between CGIAR's *Research Program on Climate Change, Agriculture and Food Security* (CCAFS) East Africa and the local radio station Mbaitu FM. The show aims to communicate local specific information in simple terms presented in the local language (Mungai and Ugangu: 2012). One farmer explained how the program had given her information on production techniques, how to apply inputs and tillage practices. Others mentioned that they learned about livestock keeping and marketing. All respondents indicated that they found the knowledge useful and trustworthy.

Another farmer mentioned the radio show *Mukulima young* ("Young Farmer"). According to this farmer the show encourages the young generation to engage in farming and to take farming seriously. He was very excited about it and explained that it is a response to the general negative perception of farming among the younger generation.

Several farmers mentioned the weekly TV-show *Shamba Shape Up*. This TV-show visits a new farmer each week and aims at generating a better income for the farmer by improving and increasing their production outcome. From what one farmer told us the advice given is easy to implement locally.

Few farmers mentioned the internet as a source of knowledge. One farmer explained that he does research on the internet to get information on the correct type of fertiliser to apply to his crops.

A few farmers told us that they get their knowledge on farming practices from written sources. One farmer showed us a book called *'Fruit and vegetable technical handbook'*, that he was given by a friend who is a former MoA employee. This was for instance helpful in choosing what type of fertiliser to apply. He emphasised that he used the book a lot and found it very useful.

4.3 Knowledge flows and social organisation

In this section we wish to give an account of which private and official horticultural organisation currently exists and has previously existed in Weru-Muru. Additionally we wish to discuss the potential benefits of group organisation as well as the challenges and constraints that hinder successful collaboration between farmers.

Generally, gathering in groups that facilitate exchange of agricultural knowledge, be it privately or institutionally organised, is a rarely seen phenomenon in Weru-Muru. Few farmers are involved in organised knowledge exchange, and from what we gather the limited number of such groups that have been in existence in the village have been short-lived and with very limited success.

Agricultural groups that do exist include quarterly Farm Forum meetings that reach around 30 farmers and a group initiated by the NGO Farm Concern International (FCI) that focuses on cultivation and marketing of indigenous vegetables. According to a member, the FCI group currently engages 8 farmers out of an original gathering of 15, and is the remnant of two groups of each 15 people started up in 2012. The FCI initiative included around two years of monitoring and supervision in addition to the initial instructions about indigenous but not commonly cultivated crops such as black nightshade, spider plant (C*hlorophytum comosum*) and asparagus (*Asparagus officinalis*). After the NGO pulled the initial close oversight of the progress of the process they allegedly invited farmers to stay in touch and actively contact them for further assistance. However, one of the two groups disbanded shortly after and the remaining group quickly lost half its members.

According to the elders, many community members expect material or even cash handouts for participating in such groups, and will quickly withdraw their activity if these expectations are not met. Additionally the elders mention that farmers in the village are competing as much as they are cooperating as they typically cultivate the same crops and cater to the same markets, resulting in some reluctance to sharing knowledge.

A number of active groups not directly involved with small-scale horticulture exists in Weru-Muru and surrounding villages. These include women's savings groups and cooperatives for dairy and coffee farmers in Weru-Muru that meet once a month at different members' houses to share experiences about any specific problems this farmer might have.

Through our data we gather the impression that participants actively and enduringly engaged in organised knowledge exchange benefit greatly from it. A concrete example of this is that the still-existing FCI group was able to obtain a personal visit from the AEO to one of their meetings - a feat that no other of our informants have accomplished. This, one of the remaining group member describes, was a direct result of being able to contact the MoA as a group rather than as individuals. Attendants to Farm Forums meetings unequivocally explain prospering from knowledge gathered at the events, and the members of the cattle group are equally positive about the results of their cooperating efforts.

One of the members who left the still-existing group after FCI retracted from their active supervision, described in the PRA-session and in a subsequent follow-up interview that he feels he needs further input and assistance in order to continue his work with the indigenous crops, but did not feel it was available. An organisation that claims to make their consulting freely available to farmers who in turn regard this same consulting as unavailable, shows the clear disconnection between the ministerial extension sector and large groups of local horticulturalists.

Several farmers talked about the possibilities of more widespread social organisation, or even a horticultural cooperative, as a very positive prospect, but simultaneously consider it almost unthinkable. Many informants started evading questions when asked about whether more initiative could be expected on their part. Even the elders, when directly asked about outlooks for cooperative and more extensive collaborations, would proceed to talk about little more than acquiring mass discounts on fertilisers.

We have made unsuccessful attempts at setting up interviews and emailing questions to the Kereita Dairy Cooperative to discuss their experiences with establishing social groups and entities and views about hindrances to this.

5. Discussion

In this chapter we address all three sub-questions by following the theoretical framework outlined in chapter 2. Furthermore we apply and discuss the distinctions between endo- and exogenous as well as tacit and codified knowledge to the data presented in chapters 2 and 3.

We will argue that there is a connection between endogenous and tacit knowledge, and that the different identified types of knowledge are both differently distributed and deployed by farmers in Weru-Muru.

Following the model of knowledge proposed by Fredrik Barth, we will argue that an analysis of the content of knowledge is insignificant if its means of acquisition, dissemination, and deployment is not appropriately considered. Hence we seek to examine types of knowledge and knowledge flows, as well as the social organisation in which they are set, as interrelated concepts.

Applying this triad of concepts to our empirical findings we have been able to identify significant differences in flows between distinct types of knowledge, with subsequent consequences as to what types of knowledge is adopted by whom and how. One major distinction is the dichotomisation of endo- and exogenous knowledge. The content, or corpus as Barth refers to, of these discrete types of knowledge is greatly different, as the very interiority that makes this knowledge endogenous means that new ideas are rarely introduced in this sphere, leading it to generally preserve the status quo. Conversely, change is more easily invoked from external sources who in turn can also be influenced by any number of interests - economic, ideological, etc.

Endogenous knowledge sources we have identified in Weru-Muru include farmers' own experiences, traditions[10] and handed down skills. This is most often acquired either individually or through processes of symmetrical circulation and reciprocal exchange, such as that occuring between family members and neighbours. The knowledge farmers absorbe from these endogenous sources are dominantly tacit, as they primarily build on experiental, unarticulated learning.

In stark contrast, exogenous knowledge sources account for most of the codified knowledge circulated. This is mostly disseminated asymmetrically from external actors and authorities such as the MoA, NGOs and agrovets, with varying degrees of attention being paid to locally specific structures.

From what we have gathered, one of the critical factors to take into account when trying to successfully disseminating knowledge from an exogenous position, is the relative unreceptiveness and general hesitance towards actively initiating contact with formal, external sources, that is

[10] Such as the traditional farming calendar, see chapter 4.1.

widespread among the interviewed farmers in Weru-Muru. This might also account for the priveliged position of agrovets as the sole provider of certain types of advice, as many farmers perceive services and assistance from official sources such as the MoA as unaccesible in their daily lives. Correspondingly, it is our clear impression that the activities of official actors - namely the MoA - that have been most successful are the ones that have sought to engage with farmers on their own premises (in both senses of the word) rather than require that community members actively seek out officials for guidance. A prime example is the Field Days that the MoA undertake in cooperation with a number of different actors ranging from KENVO to chemical companies, during which the aforementioned disconnection between many farmers and official institutions to some extent is successfully, albeit temporarily, overcome (see 4.2.1). Contrarily, initiatives such as the groups initiated by FCI (see 4.3) seem to often lose momentum as soon as day-to-day presence ceases.

A notable exception to this is radio shows on farming, which we argue operate liminally between endo- and exogenous spheres. In many ways the radio constitutes an external source, but farmers emphasise its local qualities, such as that the shows are in Kikuyu and invite local farmers to phone in inputs. A further trait of endogeneity is that the knowledge distributed through the radio shows is individually adopted and deployed. But most significantly, the identified issues of access that negatively effect knowledge flows do not amount to a limiting factor in regards to radio shows.

Our second main analytical distinction between separate types of knowledge is that of *tacit* and *codified* knowledge (see 2.2). Tacit knowledge as we experienced it in Weru-Muru largely, but not completely, overlaps with the described endogenous knowledge in some ways, as it is largely handed-down or experientially or individually acquired, resulting in farmers often knowing how to carry out certain farming methods, e.g., but without necessarily knowing why. This is exemplified by farmers who rotate crops without being able to explain the benefits, some cases of farmyard manure application, and could explain why maize remains popular and extensively grown despite its poor yields (see 4.1).

With just 10 days of immersion in the field we do not have the means of satisfyingly asses the extent of flows of tacit knowledge in Weru-Muru. However, Mackinnon and Cumbers (2007) argue that transfer of tacit knowledge is easier in tightly knit social networks where actors have frequents interactions (see 2.2), and based on our interviews and observations we suggest that the better part of decisions made by farmers in Weru-Muru are informed from within the realm of tacit knowledge. Nevertheless, as tacit knowledge is simultaneously prevalent and not directly or communicatively transferable, we also argue that knowledge flows in many instances are constrained by types of knowledge.

6. Concluding Remarks

In the present paper we have extracted and analysed data from the field related to our research questions and reflected on the methodological strengths and shortcomings. A brief condensation of these findings and reflections will be presented in the following.

Our analysis shows that the most influential types and sources of knowledge are tacit and endogenous. Of exogenous sources, the agrovets are the most important, notably on areas of farming practices concerned with P&D management and fertiliser applications - areas in which they are close to having a monopoly on disseminating knowledge.

A key aspect to consider when evaluating knowledge flows in Weru-Muru is an apparent disconnection in expectations and perceptions between many farmers and official sources such as the MoA and certain NGOs. Especially the ministerial extension services are widely perceived as unaccessable by many farmers, while local AEOs simultaneously requesting more initiative from farmers. This disconnection highlights an enduring issue of access to exogenous knowledge that is more complicated than whether or not certain institutions and services are formally available.

Availability also remains an issue in the sphere of endogenous knowledge flows, as many farmers cite limited trust in advice from neighbours, or hesitance in sharing experiences with them - and some even

regard other farmers as possible sources of consciously bad advice, fueled by a mentality of competition. Regardless, this sort of trust-related hindrance in access is in no way nearly as wide-spread in the endogenous spheres as is the case with exogenous knowledge. Consequently, there is a significant difference between endo- and exogenous knowledge, both in the corpus of the knowledge, but also in how it is transferred and obtained, but that both are hindered by lack of trust and acces.

Hence, we conclude this situation does not allow new ideas from outside the community to be easily absorbed and implemented, which in turn conserves the status quo - and supports the Barthian notion that *knowledge is conventional*.

Although we are not able of meaningfully conclude on this we have identified tendencies regarding the farmers' level of educational and age as possible influencers of the personal filtration of and trust in knowledge sources. In this sense the different flows (circulation, dissemination and exchange) of knowledge are also encouraged and constraint according to these factors. Another tendency we identified was that farmers with most sources of knowledge tended to be more critical towards certain sources of knowledge - something we conclude is related to a personal triangulation of knowledge.

All of our findings, however, must be understood in the light of some methodological shortcomings including limited time of immersion in the field and lack of control on the sampling strategy as well as of the interview situation due to language. With this in mind we have tried to cope with these constraints by taking these frailties into due consideration and utilise our interdisciplinary capability to triangulate results to achieve meaningful insights about knowledge flows regarding agricultural practices in Weru-Muru.

7. Knowledge and farming practices in synchronic and diachronic perspectives

In a research on *The role of personal information sources on the decision-making process of Costa Rican dairy farmers*, Solano et al. (2003) provide evidence that certain characteristics of the farmers' such as age, level of dedication to farming, educational level and distance to the sources of information are significant factors in determining the farmers' priorities of the different available sources to information. Even though the context is notably different from our research site, the findings have turned out to be quite similar. It is tempting to conclude that the above mentioned characteristics always influence how knowledge sources are prioritised, however, we do not have consistent data to support that. But we cannot ignore the relevance of the different knowledge sources available in the farming communities and the history that rests upon the farmers.

Resource rich areas like the Central Highlands of Kenya receive an immense pressure from exogenous sources trying to define the future of these farming communities. They seem to work as a magnet for both private, governmental and non-governmental entities with often diverging interests, while in other cases the ICT services seem to be the main contributor to the external pressure. Meanwhile, many farmers seem to be hanging on to traditional, endogenous sources of knowledge with one hand, while reaching out with the other hand towards whatever knowledge source is accessible and compatible with the farmer's conviction. In this sense they seem to be hanging on to personal relations of friends and family, while reaching out for help due to a fear of being outcompeted by neighbouring farmers who are fueled by the same fear.

In this report we have touched upon the theme of social organisation and the low degree of this. Developing a thorough theory about the constraints to systematic knowledge exchange and group organisation based on our empirical findings has not been possible within the framework of this report, but we would like to propose a few possible analytical approaches for further research.

Firstly, we have been told that the last few decades have seen the rise of several churches, mostly protestant, that are new to the area. The praise of individualism and the preaching we heard in the church about giving away all of your money to the church - not your neighbour, not your friend and not even your family members - might be a driver of distrust and increased competitiveness among farmers and this way removing any motivation of organising and sharing knowledge. Several theoreticians have noted Protestant ethics as promoting individualistic notions of work, time and money, and linked it to the 'spirit of capitalism', to paraphrase Max Weber (1905).

Secondly, the area has been subject to a heavy NGO presence since the end of the colonial era. We find that further research into the possible development of subsequent cultures of dependence and the effects this have on shaping dispositions towards social and professional organisation among farmers, could provide a deeper understanding of the factors constraining the farmers.

Then, in today's communities where history of colonialism has left its clear traces and exogenous entities try to make their way into the mind of these communities, Paulo Freire's (1969) questioning of the values of indigenous knowledge and the Western development project once again becomes relevant. They raise the question of whether we should continuously encourage exogenous entities that all claim to represent the interests of *the Indigenous*, or rather let the Indigenous be left to define development - or whether maybe we could imagine a rewarding dialogue between the two where the indigenous' personal triangulation of information is more encouraged (Morrow 2008).

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Appendix I: Synopsis

Knowledge flows influencing farmers' choice of crops in Weeru-Muuru, Kiambu County

Interdisciplinary Land Use and Natural Resource Management
SLUSE 2015

Synopsis for field studies

Students:

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Final synopsis 20th of February
University of Copenhagen

1. Introduction

The agricultural context of Kenya
This introduction to the agricultural situation in Kenya is based on the Farm Management Handbook of Kenya (henceforth referred to as The Handbook) published by the Kenyan Ministry of Agriculture in 2007.
The objective of the handbook is to assist the agricultural field advisor (such as the Agricultural Extension Officer (AEO) or the District Agricultural Officer (DAO)) in the specific district. The agricultural field advisor is often in need of

scientific training, which the handbook is compiled to assist. The handbook also targets officers from different Ministries and farmers in general – especially young farmers (Hornetz et al. 2007).
According to the handbook Kenyan farmers have generally been well informed about the potential of their land, the labor force of their family and production techniques. However a rapidly increasing population cause new demands for the farmer. Today the farmer is expected to feed the growing population and also earn a major share of vital foreign currency through exports to support the economic development in Kenya. Traditional farming methods and practices are no longer capable of meeting today's demands instead new scientific methods must be implemented. The knowledge of these methods are available in Kenya but not at farm level (ibid.).
Knowledge is a basic general constraint for developing the farm sector according to the handbook. If this knowledge gap is met output of the agricultural production could be considerably increased (ibid.).
Recently a production shift towards more vulnerable crops has occurred in Kenya. High maize prices cause a competition of maize with sorghum and millet. Maize planting in the sorghum and millet zones increases the risk of famine in marginal areas as sorghum and millet are more drought-resistant and require less water than maize. According to the handbook the higher risk with maize production is taken as farmers expect internationally aided assistance in case of harvest failure (ibid.).
Not only high prices cause the production shift towards increased maize production. Due to social changes and nutritional preferences maize have reached a higher status than sorghum and millet, which today is considered backward (ibid.).

The agricultural context of Kiambu County
Kiambu County area covers 1207,4 km2 and is located in an agro-ecological zone 2-4 in the central Kenyan Highlands. The altitude ranges from 1400 m to 1800 m above sea level. The soils in the area are moderately to highly fertile (Hornetz et al. 2007) and the county has bimodal rainfall between March and May and in October and November and an annual rainfall above 1500 mm (Wabwoba 2013).
Kiambu County is the most densely populated district in the Central Province with a total population of 834,378 (ibid.). As the population have increased the acreage agricultural land available per household or per person have declined. This decline cause serious negative impact on the agricultural production in the district (Hornetz et al. 2007).

70% of the population in the county is engaged in cultivation of crops. The majority of farms are smallholdings, which make up 90% of all farms in the county (Wabwoba 2013).
The major cash crops cultivated in Kiambu County are coffee, tea, and pyrethrum. Coffee is grown on 14,700 ha, tea is grown on 3,500 ha, and pyrethrum is grown on 200 ha (Hornetz et al. 2007).
Maize and beans are the most dominant food crops of the annual and bi-annual crops followed by Irish potatoes and kales in Kiambu district. Banana and avocado dominate production of the perennial crops followed by fruit trees and oranges (ibid.).

2. Aim of the project

The aim of the research is to examine through which sources explicit and tacit knowledge is acquired by the small-scale farmers in the Weeru-Muuru village of Kiambu County, and how particular knowledge induces a certain outcome in relation to what crops are grown.

3. Research questions

3.1 Main research question:

How do knowledge flows regarding agriculture contribute to determining small-scale farmers' choice of crops in Weeru-Muuru, Kiambu County?

3.2 Sub-questions:

1. How is knowledge acquired and transferred through formal and community sources?
2. How do socioeconomic factors such age, gender, economy and education level influence the attitude towards different sources of knowledge?
3. How does land scarcity (caused by population growth) impact the farmers' choice of crops?
4. Which knowledge sources influence the farmers' choice of crops?

4. Concepts of knowledge

In these paragraphs we wish to clarify our conceptual understanding of knowledge and how it's assimilated and distributed.

Following the theoretical outline of Barth (2002) and Solano et. al. (2003) we wish to identify discrete *types* of knowledge as well as different knowledge *flows*,

understood as exchange, circulation and dissemination of knowledge in a specific setting or social system. These terms are largely derived from Barth's model of knowledge, wherein *corpus*, *medium*, and *social organisation* are consideres as three interconnected faces of knowledge. The corpus includes the assertions and ideas about the world, and the medium describes partial representations and means of transfer of knowledge. These closely resembles what we term 'types of knowledge' and 'knowledge flows'. Finally, the social organisation regards distribution and employment of knowledge within instituted social relations (Barth 2002:1, 3). This is an essential point to Barth as he emphasises that knowledge is endogenously constituted, i.e. constructed within certain traditions and therefore always *conventional* (ibid.:5). Informed by these theoretical findings, social constitutions of knowledge types and flows will be at the center of our investigation.

Solano et. al. (2003) offer an example of a *multi-dimensional preference analysis* (MDPREF) in regards to farmer's choices. They locate the most significant personal sources of knowledge such as 'family members', 'other farmers', and 'technical advisors', and evaluate them in relation to separate phases of problem detection and solving. Maybe more so than the specific findings of the study - that family members and technical advisers are the preferred source of information and that preferred sources are relative to phases (ibid.:17) - this study holds relevance for us as an example of the types of insight it can generate to identify specific knowledge sources and correlate them to temporal factors or other variables.

Regarding the classification on information sources, Errington (1986) provides a framework of distinguishment in terms of *internal* and *external* origins; *direct observation* or *verbal* or *written* medias; or sources that rely on *numerical data*, *personal comments,* or *own experiences* (Errington in Solano et. al. 2003:4). By and large, we will follow this framework in terms of categorisation, and use a juxtaposition of *formal sources* (such as government information or public education) in opposition to *community knowledge* (such as personal experience or local knowledge exchange).

Depicted in Figure 1 are the relevant sources of knowledge that we assume to be existing, significant and accessible to some or all farmers in Weeru-Muuru.

CATEGORY	**SOURCE**	**TYPE OF KNOWLEDGE**
Formal sources	The Farm Management Handbook of Kenya	Written; numerical data

	Extension officer	*unkown*
	NGO projects and workers	Verbal or written
	Farm Field Schools	Education
Community knowledge	Personal experiences	Direct observation; embodied skills
	Neighbours/other farmers	Verbal
	Local farmers organisations	Verbal
	Handed-down information	Verbal; practical
Sources that are potentially formal or informal	Radio, TV and other news media	Verbal; discursive
	NGO or agro-banks selling cheap tea seedlings	Experience

Figure 1: Knowledge sources divided according to category and type.

5. Site of study

The literature search for site information on the specific site, Weeru-Muuru, did not give any results. The search for site information by using maps and Google Earth was also fruitless. We have then contacted Prof. Wahome and our counterpart students in Nairobi, who could provide us with some sparse information.

According to Prof. Wahome Weeru-Muuru is situated less than 70 km from Nairobi and is served by a reasonable road system with vehicles of various types. He could inform us that the farmers in the area are smallholders and grow horticultural crops, maize and fodder but did not have any information regarding the number of households and landholdings.

Our counterpart student, Josphat Kinuyu Kiunga, could also provide us with information about cultivated crops, which he told us was maize, beans and horticultural crops. He also believed there is livestock farming in the area. He

suggested to get information about the size of the population and landholdings from the local administrators office when we arrive.

At this current stage we do not know what kind of knowledge sources exist in the Weeru-Muuru area. We do know of different kinds of knowledge sources that exist within the Kiambu County, among them NGO projects, farm field schools and governmental projects and supervision from the local AEO/DAO.

6. Methodology

6.1 Sampling strategy

When doing sampling it is important to have some criteria for the informants, based on the aim of the research. The key informants we will be interviewing should:

1. be small-scale farmers from Weeru-Muuru
2. have arable land
3. be willing to cooperate and able to communicate with us directly or through an interpreter

We wish to get in contact with informants across different generations and genders. Farmers of different generations can provide us with information about whether the crops have changed or not as well as their motivations behind the crop choice. Furthermore, we hope to find out whether the main knowledge sources for the farmers have changed. By talking to different genders, we will find out if there exist a difference of accessibility to knowledge between them. We will try to select our informants according to *factorial treatment structures*, e.g. climatic, economic and infrastructural factors, such as slope steepnesswhich of their land, rainfall, proximity to market etc, since these factors may be a "source of knowledge" on farmers chose their crops. Apart from these criteria we endeavor to select informants as randomly as possible. Depending on the landscape, we have therefore decided to make a preliminary path through the village visiting every X household on the way.
Our key informants should have:

1. a general overview of agricultural activities in Weeru-Muuru
2. a willingness to cooperate and ability to communicate with us or through an interpreter

The key informants may put emphasis on certain factors that they consider particularly important in regards to the flow of knowledge, i.e. where farmers

look for knowledge, who come to the farmer with knowledge, what factorial treatment structures farmers base their choice of crops on, etc. With this information we will hopefully have a better basis for choosing informants and methods and developing relevant questions for our interview guides, even though the information provided of course should be processed critically (Stern 2004 & Neergaard et al. 2007).

6.2 Semi-structured Interview – Key informants

6.2.1 Data needed:
The following is an overview of the data we need to gather in order to answer our four sub-questions.

Sub-q. 1:
- which sources of knowledge exist (in this community)?
    - any farmers' associations?
    - farmer field schools?
    - radio, internet, other media
    - seedling banks (commercial, NGOs)
    - neighbours
    - kins living close by
    - agricultural teaching in the "ordinary" schools
    - church
- which sources are (un)available/accessible? And to whom? (who owns the Handbook, who has a vehicle to visit the AEO? How often does the AEO visit the community? .....)

Sub-q. 2:
- which sources do farmers in general trust/rely on (distrust)?

Sub-q. 3:
- have the plot sizes changed(time period: generation...20-30 years)
- does population increase play a role?
- how is land passed on (inheritance)?
- do the farmers talk about plot sizes? Are they concerned?

Sub-q. 4:
- which crops are grown in the community?
- what are these choices based on?

6.2.2 Method:

The semi-structured interview with key informants will be used to gather qualitative and quantitative data. The data will be obtained by engaging in face-to-face interviews following an interview guide (see appendix 4).
The key informants are expected to be knowledgeable about the area and farming activities within the area. We expect them to have in-depth information and perceptions about the local farming activities and practices. From these interviews, we hope to be able to know much more about the current situation regarding our research questions and refine the questions of the semi-structured interviews if needed.
We attempt to get in contact with the following people and use them as key informants and gatekeepers.

- Community leaders
- Elders
- Employee(s) at the local administrators office
- Agricultural Extension Officer/District Agricultural Officer

6.3 Semi-structured interviews with farmers

6.3.1 Data needed:
The following is an overview of the data we need to gather in order to answer our four sub-questions.

Sub-q. 1:

- How many people in the household?
- Who are involved in farming activities?
- Do you have any livestock?
- How big is your plot size?
- Other off-farm income?
- Why do you grow [these] crops/livestock?
- What are (mention 3) the challenges related to your farming practices?
- Mention 3 positive things related to your farming
- Who do you ask for advice on your farming practice?
- Do you ever receive unexpected information? (evt based on observations)
- Do you ever share your insights?
- which sources of knowledge exist (in this community)?
- which sources are (un)available/accessible? And to whom? (who owns the Handbook, who has a vehicle to visit the AEO? How often does the AEO visit the community? .....)

Sub-q. 2:

- which sources do farmers in general trust/rely on (distrust)?

Sub-q. 3:

- have the plot sizes changed(time period: generation...20-30 years)
- what role does population increase play?
- how is land sold and inherited?
- do the farmers talk about plot sizes? Are they concerned?

Sub-q. 4:

- Which crops do you grow?
- have your choice of crops/livestock changed (since when)

6.3.2 Method:

The semi-structured interviews with the farmers will be used to obtain quantitative and qualitative data. The semi-structured interview is a face-to-face interview that will follow a pre-planned set of open-ended questions - an interview guide (see appendix 5). The already planned questions will be complemented by questions arising throughout the interview allowing for further in-depth discussion and clarification. We have chosen this method because the farmers can provide us with first hand information regarding their knowledge and perceptions.

Before the interview starts we will explain what the study is about and why we are carrying it out. We will then explain why the interviewee was chosen as a participant, how the information will be used further on and the expected duration of the interview. We will begin the interview with the least sensitive questions to build trust and make the informant feel comfortable during the interview.

6.4 PRA: cultural mapping and ranking of knowledge

6.4.1 Data needed:

To answer sub-question 1, we need the farmers to tell us what they consider important sources of knowledge. We need to know basic data such as gender, age and education level in order to find out how these factors influence the farmers' trust in the different knowledge sources, which constitute sub-question 2.

6.4.2 Methods:

<u>Cultural mapping</u>

To gather the needed data, we will use the cultural mapping to find out which knowledge sources are used by the farmer and how it is being acquired and transferred. By making one group of male farmers and one group of female farmers, we also hope to achieve insight into which knowledge is available to whom.

This will take place in the first days of our stay in Weeru-Muuru. We believe it will help us gain knowledge quickly on our theme. The information achieved through this method will hopefully help adjusting our interview guide for the SSIs with the households.
If we - through observation and key informant interviews - find out that women's role in the farming activities is insignificant, the cultural mapping will take place divided on generations, which we will then operationalise.

Ranking
We will perform the ranking exercise at the end of the stay in Weeru-Muuru as we expect to have a clear(er) picture of which knowledge sources the farmers' are familiar with. We will then ask the group of farmers to rank them according to trust and according to how frequent they make use of a given knowledge source. After the ranking we will interview the group together about the reasons for trust or the lack of this in the knowledge sources as well as find out why and why not they are using them. This will help us get more information about availability of knowledge as well as accessibility and enable us to relate this information with the socioeconomic factors mentioned in sub-question 2.

6.5 Soil sampling

6.5.1 Data needed:
We will gather information about soil fertility and quality. To determine this, we need the following information:

- pH value
- N-content
- P-content
- SOM content
- Color and texture
- Erosion indicator

6.5.2 Method:
We are using iron rings to collect volume specific samples. We will collect three soil samples at different elevations from each field of our respondents. We will only take samples from the top soil layer as the information on soil fertility will be possible to determine from these samples. The soil samples collected will be analyzed in the laboratory back in Copenhagen to find pH value, bulk density, N- and P-content and SOM content. We will make use of FAO's soil taxonomy guide to classify the soil type(s).
We apply this quantitative collection technique in order to triangulate with farmers' statements on fertility and crop choices. This will be compared with the soil classification maps in The Handbook.

6.6. GPS: waypoints and area calculation

6.6.1 Data needed:
To answer the sub-question regarding land scarcity, we will collect quantitative data on plot sizes. Furthermore, we will gather specific information about the location of our respondents' households to create a map on site specific details.

6.6.2 Methods:
We will perform area calculation of selected households by using GPS. This will be triangulated with the qualitative data collected on plot sizes. We will make waypoints to know the precise location and add them to a map. As there are large deviations in the area calculation function, we will strengthen the data by using waypoints to calculate the area manually. This will be compared with maps of Google Earth, The Handbook and International Livestock Research Institute (ILRI).

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Appendices (Synopsis)

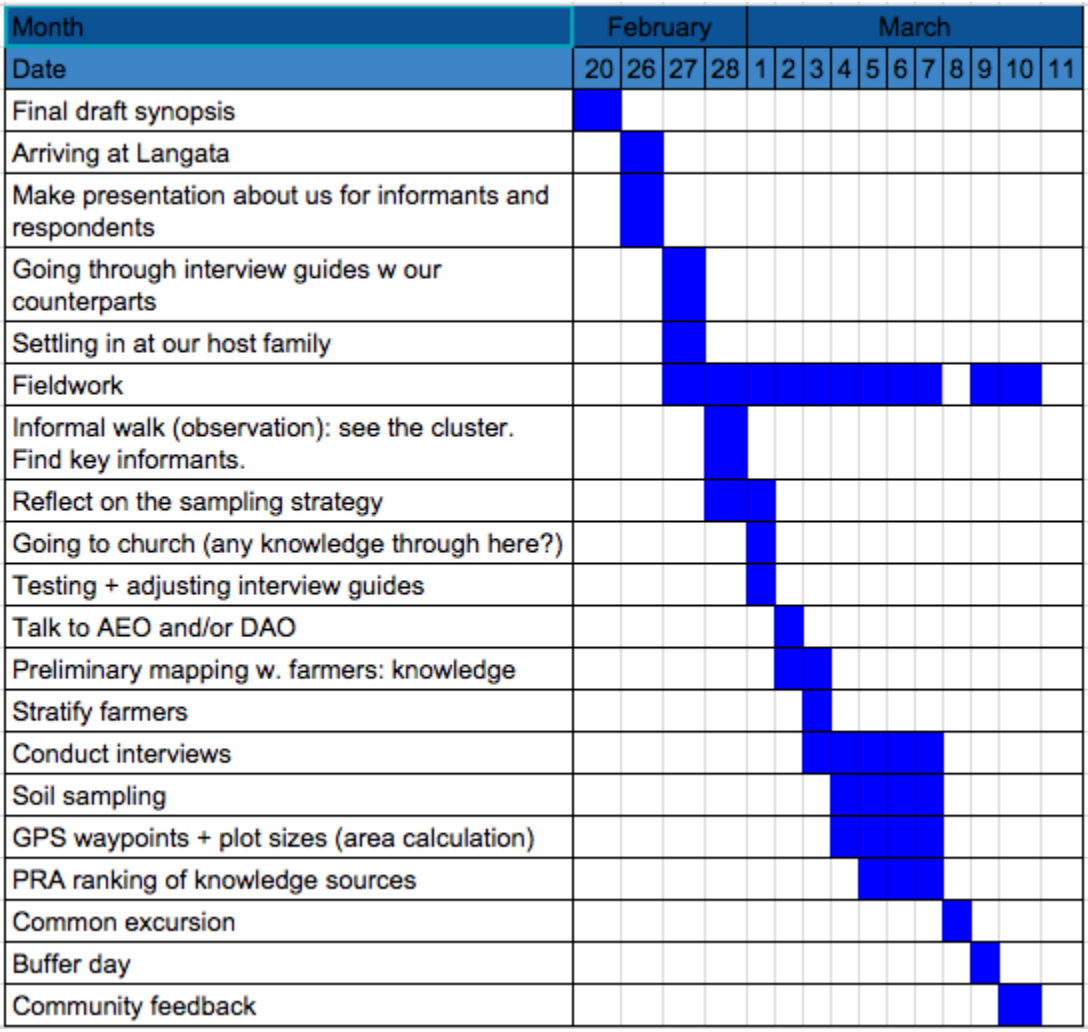
Appendix 1: Data matrix

RQ/SO	Descriptive questions	Methods	Tools
1. How is knowledge acquired and transferred through formal and community sources?	Which sources of knowledge exist in this community? (NGOs, AEO, family and neighbours, radio etc.)	Key informant interview Semi-structured interview Observations PRA	Pen & paper, drawing pen/colors, sheets GPS
	Which sources are (un)available/accessible? And to whom? (*who owns the Handbook, who has a vehicle to visit the AEO, how often does the AEO visit the community, who has internet access*? etc)	Semi-structured interview Observations	Pen & paper, GPS
2. How do socioeconomic factors such age, gender, economy and education level influence the attitude towards different sources of knowledge?	How are age, gender, economy and education determining access to different sources of knowledge?	Key informant interviews Semi-structered interviews Participant observation Litterature review	Pen & paper, GPS
	What is the distribution of labour in regards to land owners/workers, gender, generations…?	Key informant interviews Semi-structered interviews Participant observation Litterature review	Pen & paper, GPS
	What is the income level of different households? How much comes from cash crops, how much from other income-generating activity? To what extend do settlers rely on remittances?	Survey	Pen & paper

3. How does land scarcity impact the farmers' choice of crops?	Have the plot sizes changed? (*time period: 1 generation*)	Semi-structured interviews Transect walk	Pen & paper, GPS
	How big are plots now?	Land measurement	Pen & paper, GPS
	What role does population increase play in regards to land pressure?	Semi-structured interviews Observations Soil sampling & analysis Litterature review	Soil kit: iron rings, plastic bags, knife, measuring band, rubber hammer,
	How is land passed on? (*sale, inheritance*)	Semi-structured interviews Litterature review	Pen & paper, GPS
	What is the prevalent conception of land tenure?	Semi-structured interviews	Pen & paper, GPS
	Are the farmers concerned about land scarcity?	Participant observation Semi-structured interview	Pen & paper, GPS
4. Which knowledge sources influence the farmers' choice of crops?	Which crops are grown in the community?	Survey Observation Transcent walks	Pen & paper, GPS
	Which sources do farmers trust/rely on?	PRA - rankings MDPREF Semi-structured interviews Participant observation	Pen & paper, GPS
	Is first and second-hand knowledge considered equally reliable?	Semi-structured interview Observations Survey	Pen & paper, GPS
5. What structural treatment factors	How is soil quality in the area and on the individual farm and	Soil sampling	Soil kit: iron rings, plastic

influence on the farmers' choice of crops?	how does this affect choice of crops?	and analysis	bags, knife, measuring band, rubber hammer,
	How is infrastructure influencing on the choice of crops?		
	How do climatic circumstances such as water availability, rainfall, wind and temperature influence choice of crops?	transect walks interviews	pens, paper, dictaphone GPS
	Which pest and diseases are prevalent in the region, influencing choice of crops?	interview w. extension officer (District Agricultural Officer in 2013: Lucy Waweru) examination of crops transect walks	pen, paper, dictaphone,
	What are significant differences between farms in regards to size, location, soil fertility, water availability, wind exposure…?	Observation	

Appendix 2: Timeline



Appendix 3: List of questions asked Prof. Wahome and the Kenyan counterparts

"Dear Mr. Raphael Wahome

We write you from The University of Copenhagen as we have some questions concerning the area we will be doing our field work in Kenya. We are a group of four students going to the Weeru-Muuru village where we will be doing our project on a topic related to agriculture. We are all very excited to see the place and get to know the people! Hopefully, you can help us answering some of the following questions about the Weeru-Muuru area. This would be a great help for us in the planning of the focus of our project, which at the moment is on the locals' reasons for choice of farming practices and crops.

1. How many estimated households and people are there in the Weeru-Muuru village?
2. How big is the average size of land per household?
3. What are the main crops grown in the village?

4. How is the infrastructure? Particularly, how is the accessibility for bringing products to a market and to Kijabe? And how many kilometers is the village from Kijabe?

5. Are vehicles common among the villagers?

6. Does religion play an important role in the everyday life in the village and how is the importance of religion in comparison to Kijabe?

7. Are there any other particular cultural, social or historical circumstances that you think we would benefit from knowing before hand?

We are sorry about the many questions on email. Hopefully, you can help us anyway. This would give us a very good basis before doing the actual field work.

We are all looking very much forward to meeting you and hope for a mutually fruitful experience!

Kind regards,

Anna Carina, Mille, Magnus and Jorgen (Agriculture group)"

Appendix 4: Interview guide for the households

Introduction/preparations

- GPS waypoint
- Permission to record
- Brief presentation of our interest (background(s) + research topic)
- Ethics: let the respondents know that they can be anonymous and are never obligated to answer the questions, and that the information will not be abused in any way.
- Farmer names and/or systematic categorization
- Ask permission to take three soil samples from the field(s)

General on the household:

1. How many people are part of this household?

a. names and ages

2. Who are involved in agricultural activities?
3. Which agricultural tasks do each person undertake? (*age/generation, gender, knowledge-holder*)
4. Do you have other sources of income besides farming? (*off-farm work, apiculture, etc.*)

Crops and cultivation

5. For how many years have you been farming your land?
6. Which crops do you grow?
7. Do you have livestock?

8. Do you grow different crops in different seasons? Which? Why?
9. Who decides which crops to grow?
10. What do you base your choice of crops on?
a. *laws*
b. *regulations*
c. *climate conditions*
d. *economic situation (loan possibilities)*
e. *price fluctuations*
f. *market accessibility*
g. *infrastructure*
11. What do you consider the most important crops in your fields? Why?
12. Do you mainly produce for your own consumption or for selling?
13. What is your preferred crop to eat in the family (*taste preferences*)?
. other preferred foods? (*meat, honey, ...*)

14. If you were to grow a new crop which and why?
15. What are the main challenges that you encounter in cultivating your land?
a. *water/nutrient deficiency*
b. *wind damage/other climatic issues*
c. *slopes*
d. *access to seeds/seedlings*
e. *distance to fields*
f. *legislative issues*
16. What type of soil does your land consist of?
17. How is the soil fertility on your land?
18. Do you add manure?
19. Has soil fertility changed over the years?

20. How do you determine which crops to grow where? (*crop decision-making*)
21. With more land would you like to have grown different crops?

22. Have you been advised to grow these specific crops?
23. Have you gone through any particularly challenging periods regarding farm activities? Why/why not? (shocks, price fluctuations, illness, natural disaster, pest/diseases, unemployment, production, conflicts)
24. What do you consider the most urgent challenges for you and your family concerning farm activities?
25. Where do you go for advice when you encounter these challenges?

26. Do you feel you need more support in these situations and in general in relation to your farm activities?

Assets/resources

27. Were your parents farmers?
28. Do you own the same size of land as your parents did?
29. How is land passed on? How is it divided?
30. Do more people live in your household now than when you were young?
31. How do you consider the future prospects in regard to available arable land?

Knowledge exchange and human capital

32. What are your main sources of information about agricultural practices?
    a. Do you ask for/receive advice from other family members, neighbours, others?
    b. Do you get any written information regarding farm activities? (news papers, articles, flyers, handbooks, etc.)
    c. Do you get useful information regarding farm activities through the radio?
33. Are you in contact with an agricultural extension officer (AEO)?
    . If so, what information do they provide?
    a. If not, would you consider this helpful? Why/why not?
34. How often does the AEO visit Weeru-Muuru?

35. Who do you rely more on in regards to farming advice?
36. Are there any sources of information that you rely less on?
37. Do you ever get bad advises?
38. Do you share your farming experience with others? Who?
39. Are there areas regarding agriculture of which you would like to learn more?

Appendix 5: Interview guide for key informants

Introduction/preparations

- GPS waypoint?
- Permission to record
- Brief presentation of our interest (background(s) + research topic)

- Ethics: let the informants know that they can be anonymous and are never obligated to answer the questions, and that the information will not be abused in any way.
- Name of informant and occupation and/or other systematic categorization

General on the informant (ex: AEO):

1. Who is your employer?
2. How long have you had this job?
3. What are your main tasks?
4. In what areas do you provide your service?
5. How often do you go to Weeru-Muuru?

Farmers in Weeru-Muuru?

6. Do you know how many people live in Weeru-Muuru?
7. Do you know how many households in Weeru-Muuru?
8. How big is the average arable land per household?
9. Do you know how many of these households have agricultural production?
10. Has this changed over the last 20-30 years? If so, how?
11. Are the agricultural products mainly for subsistence or for selling?
12. What are the main crops grown in Weeru-Muuru?
13. Why do you think this/these crops are predominant in this area? (*motivations for crop choice*)
14. Are there any specific causes for choosing a specific crop or livestock (status/religion)?

15. Do the farmers have other income sources? If yes, which?

16. Does population growth play a role in land availability?
17. Do you experience any concern from farmers regarding land scarcity?
18. How is land passed on? Do they rely on traditional ways of dividing and passing on land?

Knowledge exchange and human capital

19. Do you provide any recommendations related to choice of crops?
20. Do you know of other institutions that provide the farmers with advice regarding farming activities

a. choice of crops?

21. Where would you say that the farmers get most of their information regarding farming activities?

22. Are there any farmers' field schools in the area? If so, how is it used by the farmers?
23. Are there any farmers' association? If so, how is it used by the locals?
24. Are there any NGO's working in the area? If so, how is it used by the farmers? What information do they provide for the farmers?
25. Do the local church provide advice on agricultural activities?
26. Are there any commercial entities working in the area? If so, how is it used by the farmers? What information do they provide for the farmers?
. e.g. seedling bank
27. Do the farmers rely on written documents such as newspapers, articles, flyers etc?
28. Do the farmers rely on radio, TV or other media for information?
29. Are you familiar with the Farm Management Handbook of Kenya? If so, do you recommend farmers to use it?
30. Are neighbours and family important when the farmers need advice on farming?
31. What sources do the farmers rely most on and what sources do they rely less on?
32. Do the farmers in Weeru-Muuru have a formal education? How many in your estimation?
. Formal agricultural education?
33. Do you consider it difficult for the farmers to get access to reliable and useful information?
34. Do you consider lack of knowledge about agriculture to be a problem in Weeru-Muuru?

Appendix II: Applied Methods

APPLIED METHODS	AMOUNT
Mapping (GPS and coordinates)	42 waypoints; 1 tracking; 1 manual boundary drawing
Observations (e.g. walks with Steve, walks on the farmers plots)	2 walks w. Steve; app. 10 walks in the farmers' fields; individual walks in the area almost every day
Semi-structured interviews	20 with farming responsible of the household; 4 with MEO, KENVO staff, elders etc.
Informal talks (Elders, Steve, agro-vets.)	
PRA (cultural mapping and knowledge ranking)	1 with women; 1 with men (duration: 1½ hour)
Field notes	All of us took field notes almost every day
Soil samples	10x2 bulk density; 5x2 for C:N and PoxC
Recording	App. 10 interviews, including the PRA
Photo documentation	Photos relevant to the field research

Appendix III: Adjusted Interview Guides

Interview guide for the farming responsible

Introduction/preparations

- GPS waypoint
- Permission to record
- Brief presentation of our interest (background(s) + research topic)
- Ethics: let the respondents know that they can be anonymous and are never obligated to answer the questions, and that the information will not be abused in any way.
- Farmer names and/or systematic categorization
- Note who interviews and who is present
- Where are we
- Ask permission to take three soil samples from the field(s)

General on the household:

1. Name, gender and age of interviewees
2. How many people are part of this household?
3. Is anyone apart from you responsible for parts of your farming land?
4. Do you have other sources of income besides farming? (*off-farm work, apiculture etc*.)

Crops and cultivation

5. Which crops do you grow and for how long?
6. Which do you consider the most important crops?
7. Do you grow different crops in different seasons?
8. What do you base your choice of crops on?
9. Have you given any consideration to where on your land you grow which crops?
10. Do you mainly produce for your own consumption or for selling?
11. What is your preferred crop to eat in the family and why?
12. If you were to start growing a new crop which would it be and why?
13. What are the main challenges that you encounter in farming?
14. Where do you go for advice when you encounter these challenges?
15. Do you feel you need more knowledge in these situations and in general in relation to your farm activities?
16. How is the soil fertility on your land?
17. Do you add manure, green manure and/or fertiliser?
18. Has soil fertility changed over the years?

Assets/resources

19. Were your parents farmers?
20. How much land do you own?

a. do you rent additional land?

Knowledge exchange and human capital

21. What are your main sources of information about agricultural practices?
a. Family and neighbors, written information, media, institutions, other?
22. How often are you in contact with an agricultural extension officer (AEO)?
a. What information do they provide?

Interview guide for key informants

AEO

Ministry of Agriculture

KENVO

Agro-vet

(adapted to each of the key informants)

Introduction/preparations

same presentation as for the farmers (except anonymity)

- GPS waypoint?
- Permission to record
- Brief presentation of our interest (background(s) + research topic)
- Ethics: let the informants know that they can be anonymous and are never obligated to
- answer the questions, and that the information will not be abused in any way.
- Name of informant and occupation and/or other systematic categorization

General on the informant (ex: AEO):

1. Name
2. Title
3. Which organisation/institution?
4. What are your main tasks?
5. How does a normal working day look like for you?
6. In what areas do you provide your service?
7. How often do you visit farmers in Weeru Muuru?

Farmers in Weeru Muuru?

8. Do you know how many people live in Weeru Muuru?
9. Do you know the number of households in Weeru Muuru?
10. How big is the average plot size?
11. What are the main crops grown in Weeru Muuru?
12. Has there been any significant changes (in the main crops grown)? If so, how and since when?

13. Are the agricultural products mainly for subsistence or for selling?
14. Why do you think this/these crops are predominant in this area? (*motivations for crop choice – maybe also follow-up w questions on status/religion)*
15. How do you think land scarcity is affecting the farmers' choice of crops?
16. How is land acquired? Inherited/bought/other?

Values and interests

17. Do you think that your advice is different from the advice of other sources? (eg. NGOs, other farmers, TV, etc.)
18. *questions on ideological content, financial or political interests, or any other values that can be nested in information transferred from a specific formal source*

Knowledge exchange and human capital

17. Do the farmers in Weeru Muuru have any education related to agriculture?
18. Do the farmers come to you for any advice related to choice of crops?
19. Do you provide any recommendations related to choice of crops? Whick kind?
20. Do you know of other institutions that provide the farmers with advice regarding farming activities?
    1. choice of crops?
21. Are there any farmers' field schools in the area? If so, how is it used by the farmers?
22. Are there any farmers' associations? If so, how are they used by the locals?
23. Which kind of collaboration exists between the NGOs and the farmers in Weeru-Muuru?
24. Are there any commercial entities working in the area? If so, how are they used by the farmers? What information do they provide for the farmers? (e.g. seedling bank, agro-vet, …)?
25. Do the farmers rely on
    1. written documents (such as newspapers, articles, flyers etc)?
    2. Do the farmers rely on radio, TV or other media for information?
    3. Are you familiar with the Farm Management Handbook of Kenya? Do you use it? If so, do you recommend farmers to use it?
    4. Are neighbours and family important when the farmers need advice on farming?
26. What sources of knowledge do the farmers rely most on and what sources do they rely less on?
27. Do you consider it difficult for the farmers to get access to reliable and useful information about agricultural activities?

Do you think there is a lack of knowledge about agriculture in Weeru Muuru?

Appendix IV: Interview Data Matrix w/ Farming responsibles

(Each 3 pages provide the answers from 3-4 farmers)

	Household 1	Household 2	Household 3
Who conducted the interview	Jørgen + Josphat + Nyutu	Mille + AC	Mille + Jørgen + Nyutu
Date		02.03.2015	04.03.2015
General on the household:			
Waypoint number/name	later		
Name, age and level of education of interviewees	Nancy Wairimu, (F), 60 yrs, class 3	Caroline (F), 25, high school; Lucy, 40,	Sara Nyambure, (F), 30, primary (8th grade)
How many people are members of this household?	4	4: Mom, dad, 2 children	
Is anyone apart from you responsible for parts of your farming land?	no	all	Her mother
Do you have other sources of income besides farming?	no	Father works at an office in Nairobi	No, but also livestock
Crops and cultivation			
Which crops do you grow?	Maize, beans, peas, kales, potatoes, plums, carrots	Carrots, potatoes, kale, cabbage, spinach, maize	Kale, cabbage, maize, managu
Have you always grown these crops?	n/a	for more than 25 years	Used to grow carrots
Which do you consider the most important crops? Why?	Carrots, potatoes, maize, peas	Carrots, kale, potatoes because they are market ready	Kale (for selling), she takes it to Nairobi and her mother takes it to the market
Do you grow different crops during the year?	yes, crop rotation	crop rotation w carrots, potatoes; each for three months until at new crop is grown	She follows the traditional farming calendar. She knows about it from her parents.
How do you chose which crops to grow on your land?	Climate in the area, difficulties growing maize and potatoes due to frost/mist and humidity (coursed by gas emission	Depends on market demand and the climate conditions. "The crops that we like grow well in this area" [maybe vice versa...]	Separate plots. No mixing of crops. Rotation of crops.
How do you decide where on your land to grow the different crops?	Kale on the bottom of the slope, maize on the top of the slope (because lower parts receive more water)	if she notices that a crop is not doing well, she tries a new area for it	No slope. Crop rotation. No specific considerations.
Do you mainly produce for your own consumption or for selling?	Own consumption, small scale --> not much left for sale	50/50	Own consumption. Only kale is sold
What is your preferred crop to eat in the family and why?	Potatoes, peas, carrots (fast growing crops). Maize less prefered due to long growing time (6 months to 1 year)	cabbage: everyone likes it and it is easy to prepare. Potatoes: they are available.	Potatoes. Easy to cook.

If you were to start growing a new crop which would it be? Why? //Have you thought about introducing a new crop?	No other crop is of interest due to land size. Happy with what she has.	strawberry: heard that they're in demand. Not so much work to grow them and you can get big quantities on a small plot. Tomatoes are high in demand too.	More maize. For consumption (rather than buying more).
Why are you not switching to that/those crop(s) now?	n/a	Strawberries require fertiliser and seeds are hard to get because noone is growing straberries. Furthernore, they need a	Can't grow more due to limited plot
What do you consider to be the main challenges in farming? //what are the biggest problem with [your main crop]	Lack of fertilizer input because it is unaffordable. The low temperature and maize seeds variety (long growing time). In the past: lack of knowledge on the best varieties.	water (access). Lack of pipes and a machine (pumpe?). Seeds are expensive at the agro-vet. We never exchange seeds anymore bc ppl do not save enough seeds.	Overfloding when it rains. Crop diseases. Maize turning yellow.
Where do you go for advice when you encounter these challenges?	Agrovets: she presents her problem to them and they advice her on which inorganic fertilizers to use or alternative solutions.	MoA: they're going door-to-door with advice on how to apply fertiliser, do crop rotation and more.	Agrovets. They help with spray farm chemicals. No where else for advice
Do you need more knowledge in these situations and in general in relation to your farm activities?	She would only be interested in more knowledge, if she had a large piece of land	For sure! How to use chem,icals on the specific crops. I have done crop rotation for a wihile and it is not making a difference	Yes.
How is the soil fertility on your land?	Increasing degradation starting 20 years ago, generally poor soil	Very poor. Cabbage is not doing well, it was better 6 months ago. Potatoes also give less. Some areas have better soil fertility. "My idea	Average. The rain leaches nutrients from soil. She cannot tell anything about the soil quality by looking at it
Do you add manure, green manure and/or fertiliser? (why/why not)?	Manure (from livestock) and fertiliser from agrovets	yes; not green manure.	She applies manure and fertilizer. No green manure.
Has soil fertility changed over the years?	Degradation started about 20 years ago	Very different. Yield is much lower than 2 years ago.	Rain degrades (leaching), right now ok, manure not carried away. The soil has improved due to less water, not swumpy anymore because of

Assets/resources			
Were your parents farmers? (deleted)	yes	Yes, grandparents were farmers.	Yes.
How much land do you own?	½ acre	2 acre in tota. 1 acre here, 1 acre further away	1/8 acres her own. 0,5 own by the family.
Is it enough?		n/a	
do you own land separate from here?	n/a	1 acre further away	
do you rent additional land?	no	1/4 ha	They rent 0,25-0,5 acres
Knowledge exchange and human capital			
What are your main sources of information about agricultural practices?		Only MoA. Parents, not friends and neighbours. Discussion on TV and radio.	Radio: The voice of the farmer. Learnt about how to keep cows and about marketing.
Family and neighbors, written information, media, other?			She also get advice from family and neighbours.
How often are you in contact with agricultural institutions/organisations (KENVO, KARI, MoA, Agro-vet, chemical companies)		every 3rd month (MoA)	She seeks advice from agrovets
do they come to you/do you go to them?		They (MoA) come here to check up on the farmers.	She goes to them for advice.
what information do they provide?		how to make seedlings –> mulching + distance between the plants. Cabbage was a success, she still	How to apply input
is it helpful? How?		Yes (MoA), but I forgot it later.	
Who do you rely more on in regards to farming advice? // Who gives the best advice?		Do not rely on some than others; if two trusting sources give opposite advice, she tries to use common sense	Agrovets
Less? (deleted)		She wouldn't mention any:	Neighbours
Do you share your farming experience with others?			No. Not much.
Are there areas regarding agriculture of which you would like to learn more? (deleted)		<More about fertiliser and crop rotation	She would like to know more about growing cabbage.
Are you happy with your yields? Why/why not? Has that changed during the last 5/10 years?			
Other comments		She would like the soil sample results regarding the maize. Too	
Our observations during the interview			
Soil samples y/n + number			

Household 4	**Household 5**	**Household 6**	**Household 7**
Mille + Jørgen + Nyutu	Josphat + Magnus	AC + Sitati	Mille + Jørgen
04.03.2015			04.03.2015
	later	later	
Hanna Njeri (F), 29 yrs, primary school (8th) grade)	Lucy Njeri (F), 45 yeras old, form 4 (high school)	Priscilla Wangui (F), 32 years old, class 8	Justin Kimani (M), 28 years old, college. Elisabeth Kimani (F), 23 years old, high school (partly present)
		5	3
Just her	no	her husband is head of household	Yes. Elisabeth Kimani
No	livestock and women's group	n/a	Just farming
Maize, potato, kale	kale, cabbage, potato, carrots, beans, maize	Kale, potatoes, cabbages, spinach, coriander, courgette, carrots, maize, plum, fig, avocado, strawberries, peach tree, banana, sunflowers	Spinach, kale, potato, cabbage, spices, dhania, corgette
Yes	yes	yes	No. Recently they started growing dhania because it grows fast (45 days), courgette, also grows fast (45 days), can be harvested twice a week. Better price for dhania and courgette.
Maize, because it is used for animal feed	potato, cabbage, carrots, kale. Marketability and fast-growing crops.	potatoes and other vegetables. They have a short growing period (3 months). Kale is the best economically.	Potatoes, because the are both sold and for own consumption.
Most cases maize in the same place. Maize all year round.	no	every time one is harvested, they plant a different one. Rotation w. potatoes and kale.	Grows kales and spinach all year. Harvest twice a week.
The maize is used for animal feed. High priority.	n/a	considers maturation period and the cold weather. Always a different crop after harvesting.	It is better to plant something that do not take to long time to grow. That is beneficial.
So they don't stand in the shade of each other. E.g. maize and kale together.	rotation	Soil quality. Crop rotation lessens the soil degradation. (knows this from agricultural training by KENVO and field training in Limuru facilitated an NGO)	Dhania and spinach near to the water, hole, because of problems with his back (carrying water). Plant kales far away during rainy season.
Mainly own consumption, Kale is produced for sale. Sold to a middleman.	both	own consumption. If the harvest is good, they sell it at Gikomba (market in Nairobi)	1200 bundles, 90% spinach for selling, 50% potatoes for selling, 90% kale for selling. He goes to the market to see the prices. Sells spinach, kale, cabbage to middlemen with different middlemen for each crop.
Potatoes, because she likes the taste	potato bc it can be used for different meals	Potato and kale because it is available	Everything. He prefers spinach and kale, she (the wife) prefers potatoes.

Courgette	n/a	tomatoes, but it requires a greenhouse, which is expensive. Tomatoes is more profitable.	Other spices, parsley, managu, arrowroot (traditional food), he says that cancer and hypertension are caused by new food habits. People here don't farm arrowroot anymore. If he is able to farm arrow root, he thinks that people will come to him to buy them (high demand, low supply). If he can farm amaranth he will be able to support his own family. There is a good market for amaranth.
prevented by the hot climate and can only be grown in some parts of the year	n/a	it requires a greenhouse, which is expensive. Tomatoes is more profitable.	Lack of inputs. Lack of training.
Maize disease	pest, caterpillars. Eats the cabbage and sometimes the potatoes. Climate, frost	fertiliser is very expensive (but available). Husband mentions that money for fodder and land size is too little to grow enough food for the family. He wants to dig a well in order to boost the crops during the dry season	Lack of technology prevents him from growing new crops. There is lots of water in the area, but he has back problems and needs an irrigation system. Lack of technology to improve soil quality and lack of knowledge on how to farm. People still farm what there grandparents farmed. He also mentions pests and diseases. He has lots of pests on his land. He feels that he lacks knowledge on how to combat the pests.
Agrovets	n/a	other farmers	The organisation called "Farm concern" (NGO). They introduced new species: managu and amaranth. They convinced him that farming can give him cash. Talked to a friend (old man) who introduced him to which sprays to use the fights pests. Ministry of agriculture conducts field studies. They talk about new varyties and how to spray and harvest. MoA came by and introduced him to a group of people (farmers) (the farmers' forum). These forums are also announced in the church. MoA wants to know how people farm. A lot of farmers go to these gatherings. They (MoA) go around in the village and inform people about the meetings. Baba Muniu is told and tells everybody. This forum happens about 3 times a year.
Would like more knowledge on agriculture and livestock keeping	yes	yes	
Good. Prefers dark soil over red soil. She only has dark soil on her land.	poor	ok, but fertiliser and manure is needed	Used to be better (when he was in high school). The degradation is caused by to intensive farming
Fertilizer and manure	manure and fertiliser	yes (not green manure)	33 Weeru-muuru farmers (from Forum) bought manure from Masai to improve soil fertility. This is
Improving because of manure application	yes. The climate used to be too wet, now it is better, so we can harvest more	Since 2010 is has gotten worse due to the weather. Now they need to apply more fertiliser, they used to use less or nothing at all. Fertilisers degrade the soil.	If you don't farm for three years soil fertility improves. When he was in high school the soil quality was much better. Degradation is caused by farming.

yes	yes	yes	Yes
¼ acre	½ acre	1 acre	1 acre
	yes, far away. We bought it.	no	
rent ½ in the forest	used to, not any longer	Yes, ½ acre far away. It has onion and are considering vegetables.	Less than ¼ acre some distance away.
Radio: The voice of the farmer. Learned about livestock. Training where farmers meet.	one year ago, one person came to train them (?) how to grow their vegetables	Mostly other farmers. NGOs.	"Fruit and vegetable technical handbook" MoA, Kenvo, Farm Forums, friends and neighbors.
	radioshow (Mukulima), TV (shamba shape-up)		"Fruit and vegetable technical handbook" (see above). Interest in media, local TV: "shamba shape up" (program broadcasted every Saturday and Sunday
Just agrovets.	never	2 times a year they go for advice to DO's place = AEO and other officers. Sometimes they go for agricultural training in Limuru	MoA conduct field studies. They want to know how people farm. Inform farmers on good varieties, how to spary and harvest. Introduce themselves through the church. A lot of farmers go to these gatherings. They come by to inform when people will come by to train
She goes to them, and when problems with animals they come to her	n/a	NGOs: recommended black night shade (do well in the shade)	MoA comes to meet the farmers or advertise through the church and the community leader (Baba Muniu). The same is the case with Kenvo. Consider MoA, KARI and Farm Concern to be to far away. You can always drop by Kenvo and AEO.
Farm input, what seeds to grow. Advised to use another variety of maize.	n/a	they have to pay their fare to Limuru themselves (for the training)	MoA and Kenvo: farm training. Farm Concern: provide machinery and improved seeds.
	n/a	yes. Sometimes they change practices after the training. They still grow black nightshade and it is more profitable than other vegetables	Shamba Shape Up: good information.
Agrovets	n/a	the DO's place and the farmers. She assesses the advice and chooses the ones that she think are best.	Dont rely too much on media. Rely on friends and neighbors.
Neighbors. Some times she	n/a	noone	
Yes. Neighbors.	women's group	She is part of an farmer's group with 20 ppl of different genders, tribes and locations. They choose the members themselves. They plant trees at KENVO every Tuesday. They share information informally within the group about agriculture.	He shares with neighbors. If he is looking for knowledge he goes to his neighbors. Got good advice from friends. Visit friends' farms.
Livestock. Dairy Cows. Poultry.	livestock and crop production	(Husband answers): keeping cattle for milk, but they have no money to buy cows and they are missing the fodder.	
		They have lived here since 2008.	Where do you hear about change in market? Answer: sells to market in Naivasha, people come from Nairobi
	later	6a + 6b	

Household 8	**Household 9**	**Household 10**	**Household 11**
	Sitati + Magnus	Josphat + Jørgen (Supervisor - Cecilia and Cathrine?). Conducted by Josphat	Mille + Jørgen + Nyutu (conducted by Mi
	05.03.2015	Probably 06.03.2015	05.03.2015
	-0.97944/36.63536		
	Ester Wagiku (F), 38, class 8	David Irungu (M), 47, 8th grade	Ruth Wanjiku, 54, 5th grade
		5 children, wife deceased	
	Husband	4 brothers divided in 4, each responsible for their own piece of land	No. Only her
	No	Cultivates land and does construction building or whatever is available.	No other
	Beans, maize, kale, potato	Potatoes, kale, maize, carrots, obs: napier grass	Carrots, cabbage, maize, kale, potatoes, plums, courgettes
	yes	Yes. Always. Rotation of potatoes and maize but randomly.	Yes
	maize, kale, potato	Potatoes and kale because they can be conveniently consumed by farming members and sold to get some cash	Carrots, cabbage, potatoes, maize, kale
	matures fast. Kale sells well.	Always same crops but practices crop rotation.	Maize in one season, potatoes in the following, based on climate and how the parents did it
	segmentation, rotation.	Based on weather conditions and market availability	rotation with no obvious pattern
	depending on climate	Fertility factor. Kale prefers fertile land, carrots can do better in less fertile pieces of land	Slope: kale at the bottom of slope due to higher water levels.
	both, but mainly consumption	Mainly for consumption, since land is scarce.	Kale for income, rest for own consumption.
	potato, maize, beans, kale	Potatoes, cabbage, carrots because they grow faster.	Potatoes, maize because they make you full

	carrots, cabbage, tomato. For consumption and selling	Never thought of introducing new crops due to small land.	Flowers (vague answer)
	need more water than is availabe	If bigger land, he would increase productivity of carrots and potatoes	Because worms cut the crops and due to lack of capital for investment
	dry seasons. Worms.	lack of crop resistance from pests and diseases	maize: last year had pests/diseases Kale: has aphids this year. Climate has been a challenge and has made her farming less successfull throughout the years
	agrovets. Never other farmers or AEO.	Agrovets. Advice: application of pesticides, farm input that they apply. He does not think he needs help because he land is so limited so the problem is not big enough, yield is not big enough. Example: waste a day finding the AEO, distance to AEO. However, he considers the AEO helpful, but difficult to get time when you are the breadwinner of the family	Agrovets (farm shops). No other alternative to agrovets. They give advice on chemicals (for cabbage and kale). She always buys at the shop
	yes. Wants training about agricultre.	Yes, training. Time constraint. However, he is open to easier ways such as the phone and TV that are less time consuming.	
		Varies. Close to homested higher fertility due to manure application. He can see this by the different qualities of the kale.	Average. Based on the yield and comparison to earlier years.
	uses farmyard. Mix green manure and	Manure, fertilizer and farm yard manure	Fertilizer, manure, no green manure. Challenges with rainfall draining
	redundant. Only been here three years	40 years: changes according to the manure supply. Lacks funds for manure.	10 years: improvement

	yes		Yes
	½ acre	1/2 acre	1/2 acre
	no	No	No
	no	No. Due to low income.	No
	agrovets	Agrovets. Does not have time for others	Parents, agrovets (fertilizer application) talk with neighbors (but often not applied)
	radio	He shares knowledhe with neighbors	No, but may be interested in training programs. She has never heard of the Forum.
	agrovets when buying fertilisers or when there are specific problems	Has heard about the farm forums, but are not a priority. He heard about the farm forums from market and farmers.	
	she goes to them		
	details on new crops, production, yield increase		
			Interest in increasing yield and income. She has the same yield as the neighbors

Household 12	Household 13	Household 14
Josphat + Jørgen (conducted by Josphat	AC + Mille + Nyutu	AC + Mille
03-06-2015	06.03.2015	06.03.2015
Gerah Wangui (F), aprox. 60. Never went to school.	Sarah (F), 50, primary (7 years)	Anthony Makinye (M), 31 years old, certificate in engigeering from poly-technical school
4	4: herself, husband, 2 sons	2: me and my mom
Shared responsibility of land with her son	all in hh	no
sells vegetables in Kimende market, and buys from other farmers	no, husband retired	Artist: makes masai belt and sells it at the market in Nairobi
Potatoes, maize, cabbage, napier grass, spinach (in small quantities), kale carrots	carrots, vegetables, beans, kale, cabbage, plum tree, potatoes	Dhania (coriander), spinach, kale, courgette, maize, plum tree, "ribena" (like oranges w many seeds), pear, napia grass
yes	yes	In 2008 tried courgettes, but stopped because they didn't do well – later he started again. Started with dhania in 2008.
Carrots and potatoes most marketable	potatoes, cabbage, beans, carrots. We eat them.	
No	yes	
On slopes they only grow trees	crop rotation: to stabilise the soil fertility. Not systematic rotation, plant whatever seeds are available.	It depends on what is near water and what requires sun/shade. Courgettes need water and sun; kales can be planted anywhere, dhnaia should be planted in the shade. Spinach rotates, never plants at the same spot after
	n/a	
Yes, produces for consumption and for sale	Balanced 50/50	Kale and maize are for own consumption, everything else is for selling
Cabbage is most consumed and also potatoes	potatoes, cabbage, beans, carrots.	Rice and potatoes (sometimes they grow them, sometimes they buy them)

She has not thought about introducing a new crop	No, it is too dry.	He is trying out many new things: courgettes, dhania, leaks. If they do well, he produces them quantities. He tried leaks for the first time last year.
	n/a	n/a
Crops: pests and diseases, rainfall: drought. Lack of capital to bbuy fertilizer. Maize diseases have been reduced by changing the seeds. Agrovets adviced her to use new seeds. Earlier variety 614 which caused the disease.	Lack of rain. Gets extra water from the river.	without water. He has a well (his mother dug it many years ago), but water level has dropped. Also goes to the river. Wehen the weather changes, there is enough (in the rainy season). They have a tank to collect water, knows about it from his grandmother who had one. Company water is not reliable. Other problems are lack of
Agrovets. They come to her when dealing with livestock.	Nowhere.	
Yes. But (someone?) is not always. Lack of time.	Would like more knowledge about access to water. Also more on crops, high yield and soil fertility.	
Crops in good health	Not that good because of the sun/heat.	Good soil fertility, but manure has to be applied.
Yes. Applies manure and fertilizer (but only a little due to lack of funds	She adds manure and fertiliser to improve soil	He keeps applying manure. If fertiliser (urea) is not applied, dhania does not
Improved due to greater manure application. Improved soil, but depends on manure applied	No change. A lot of heat causes low crop production.	When he applies manure it changes; he prefers manure over fertiliser as fertiliser only lasts for three weeks and manure up to four years. He tried manure in 2013 for the first time. Manure is for the soil and fertiliser is

1/4 acre: divided in two	¼ acre	¼ acre
She is comfortable due to manure application	Not enough, but she doesn't have money to buy more.	
no	no	Yes, but he leases it out because it is too far away (need labour and/or the
no	no	
Agrovets, no other. Does not rely on neighbors	MoA: a certain person (she didn't remember the name)	TV: Shamba Shape-up → discovered things we did not do right. Learned that he should apply a certain type of pesticide to avoid mildew on the courgettes. Going to the local market: if something is in demand at the local market, it is also in demand in Nairobi. A friend told him to apply urea when growing dhania. This friend has experiemented with it.
	Radio show: Voice of the farmer → here she learned about livestock and cows, but	
plant trees and fruit tree from Nelson from Kenvo. Goes to Kenvo nurseries twice a week: on how to plant seedlings. Women's group (on agriculture): "ahadi kwa hadi" on entrepreneurship to find market for fruits and trees.	Had agricultural training by MoA.	
	She goes to training (organised by MoA) twice a year in Bathi.	
	She is learning about crop rotation, space between potatoes, manure handling	
	It is very helpful and she still uses their advice	
Kenvo: more resourceful, agrovets: just buys, but never asks for advice. Only on application.	n/a	
	Sparsely	
	Yes, have enough to feed my family; when there's rain, there is enough food	
		They moved to W-M in 1988 and in 2008 he took over the farm land and

Household 15	Household 16	Household 17
Josphat + Magnus	Josphat + Mille	Sitati + Mille (Samual present)
05.03.2015	06.06.2015	07.03.2015
Mishek Kere (M), 55, class 7	Grace Mugure (F), 42 years old, Form 1	Anthony Kuria (M), 30 years old, diploma in engineering
	7 people live here	Live alone
Wife	Her parents	the farm land. Comes 3 times a week and decides what needs to be done.
no (observation and shamba-walk proved differently: sells timber)	Livestock keeping. Sell vegetables	-
Answered: Potato, carrot, maize, beans, kale, cabbage, manago, spinach. Observed: banana, aloe vera, bamboo, onion, pumpkins, several types of beans, plums,	Potatos, maize, green grams (beans), pumpkins, sukuma wiki, beet roots, carrots, spinach	Potatos, carrots, maize, spinach, cabbage, dhania
Answered: yes. During shamba-walk he said that he has introduced bananas and advocados as the climate has gotten warmer.	Always grown the same crops	Yes. Took over the farm last year in december from his grandmother.
All. Either for consumption or selling.	They are all important. Depend on market. Sukuma wiki is the most important crop at the time because of the market demand.	Potatos because of the market value. Grow large quantities. Sell not only for consumption but also for growing. 2nd most important is kales. Also because of the market price.
Same throughout the year	No. The same crops are grown during the year	Yes. Considers the weather. After Janurary / February you start planting (the end of the dry season).
Depending on marketability. - Later reveals that "a man" introduced managu to him. Maybe from KARI or FCI?		Depends on fertility of the land. Carrots need lot of care. Tillage. If weeds shut again dig again.
Random strip farming. Crop rotation, no specific system.	This depends on the soil fertility. Sukuma wiki requires fertile soil and so do cabbage, kales and potatos. Desition also beased on tradition and current market demand	Before he took over the land it was not in a good condition. Mother was sick. Weeds grew very much. Still fighting the weeds.
Both. No specific crop is solely for consumption or marketing.	Both. Depends on the family. When they are few they sell more at the market.	Mostly for selling. Sell in Nairobi. Takes it to Nairobi himself.
Potato, maize, beans.	No one is preferred. All crops are consumed. They eat what fits together.	Potatos. Like them. But he dont like them that much. His favorite is ugali.

No. No other crops than what I'm growing can do well here. I've tried other crops unsuccesfully-	Corgettes and dhania because of the high market value. Dhania grows fast.	Fruits: Rabena. Avocado. Strawberry. Passion (fruit?). Because of the market demand and value. Knows about that from the newspaper and from talking to other farmers. 'Someone else is doing it and it is doing well'.
	Because of land scarcity. Would have to replace with other crops. And because of lack of water.	
Plant diseased. Cold weather (for potatoes). Has been distrubed by monkeys.	Pest and diseases (sukumawiki and potatos). Land scarcity. Frost (spinach and potatos). Water (only get water from the river)	Pests. Flies (white flies). Cost of fertiliser. Water availability
Agrovets. Has tried going through the ministry but without success.	Agrovets. They give advice on pesticide. She gets advice and then buy products from them.	Dont go for advice. Tackle them by himself. Do research on the internet. Visit different company web sites and compare. Try their products. If they do not work he tries new ones. Goes to the market. Go to Agrovets. They dont give bad advice. They do their best to market their products. It is up to him to do research and then try.
Wants to know more about maize as it's not performing well. Failed to get it from ministry. "The agricultural	Yes. Knowledge on livestock keeping and more knowledge in generel.	
Good. Some is more sandy, some is more "black".	Good. Because she apply manure and fertiliser.	Some parts fertile some parts not fertile. If not good he apply compost and manure
Manure, but no fertiliser. The fertiliser hardens the soil	Manure is the best to apply. Does not destroy the soil structure and soil particles.	fertiliser. Fertiliser depends on crop. Prefer manure. Fertiliser increase soil acidity - knows about this from
	It keeps on changing because some crops (sukuma wiki) need more nutrients. Crops takes nutrients out of the soil.	Increasing because of the manure applyed. More fertile today than it used to be.

Yes		-
¾ acre	Less than an acre.	5 acre. Cultivate 3 acres. The rest is for grazing.
	better. Havent got more land because of money.	Enough for now.
no	Yes. Within Weeru-muru. Less than an acre (growns potatos here)	No.
no	Used to rent 0,5 acre but not anymore.	No.
Teaches himself. Utilises background from working in Kenya Meat Comission for 10 years. Uses commom sense.	Apart from agrovets. Radio: Inooro FM. It is about green housing farming. Has only listened to the program but not practised the advice given. Because land is scarce she cannot practice what she have learnt. TV: (Citizen TV) about livestock keeping. She practices these advice on livestock keeping.	There is no information in Weeru-muru.
Neighbours. Inooro FM. Agrovets.	Neighbors: get information here as well.	and aloe vera cultivation. Do attend Field Days (BAYA) Mostly about pigs and chickens. This is of no interest to him. Books: bookslets about rabits, chickens and cows.
	keeping than about agriculture. Have never been in a training program. She knows about a group of women (old women) who have been part of a training program. She tend to get information from them. But they were not ready to share all - mainly because	like being in contact with them in the future. About the MOA: 'To me they are just there'. Dont help him. Kenvo: specilize in trees. Also in farms? Do the have knowledge about agriculture? Have not heard about Farm Concern International. Have been at KARI. Follow what they do.
	She wish that MOA would come to her and teach her on how to cultivate crops and keep livestock	Went to KARI himself.
	-	-
	-	-
		All informants give equally good advice.
	-	
	Yes. Other farmers. Neighbors and family members.	Do share knowledge in informal forums. Other farmers. Tries other farmers' advice if own experiments are not working.
	Crop cultivation and livestock keeping.	
	Depends on different weather conditions.	
He is part of a group of which the wife is secretary. They've		

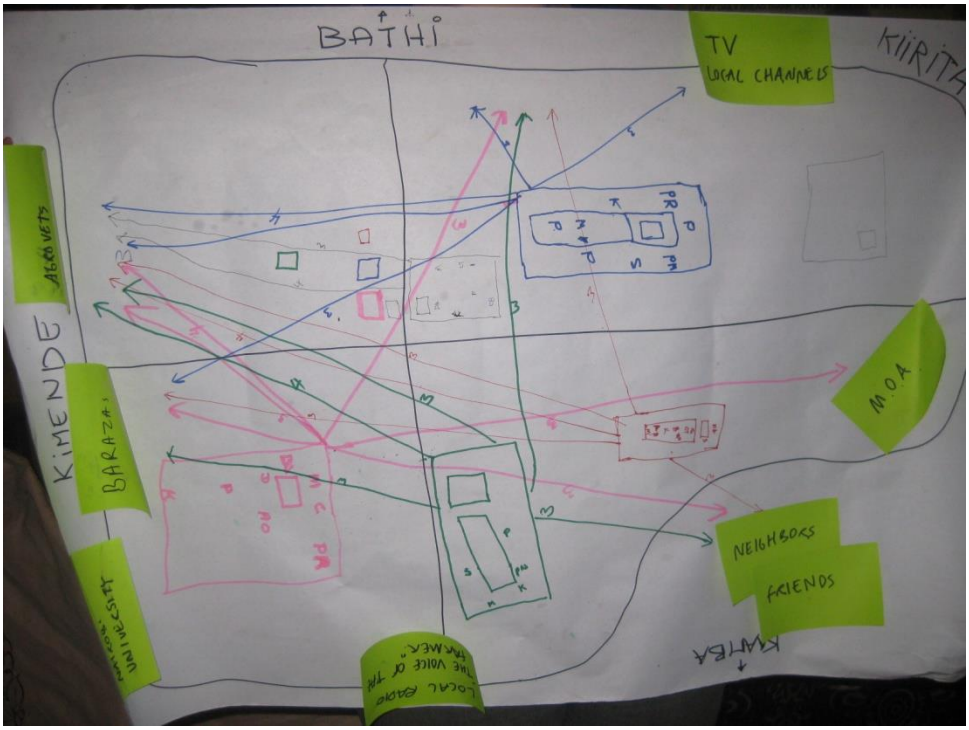
Household 18	HH 19	household 20	household 21
Sitati + Mille + Samuel	Josphat (+Magnus)	Josphat + Magnus	Magnus + Josphat
07.03.2015	03-05-2015		
David, 72 years old. Form 4.	Jennifer Muthoni, 37, form 3, female	George Karare, 28, form 2	Monica Washera, 27, college
-		-	7 - herself, parents, brother, sister, nephew
Wife and daughter. Can engage 5 workers when the rain comes.	No	-	household participates. Father is focused on livestock
-	No	Livestock	Yes. Herself + brother are employed (cashier, matatu driver), dad is retired teacher
Parsley, rocket, cauliflower, broccoli, carrot, maize, radishe, fennel	Potato, cabbage, courgette, coriander, beans, 1 line of maize	Kale, carrots, maize, potato, onion, beans sometimes	Coriander, kale, spinach, potato, cabbage, maize, carrots, beans
He has more than 40 years of experience. He has experimented with spices for more than 10 years. Learned by own experience. Try and error.	Courgette and coriander was introduced 1.5 years ago, acquired from market in Nairobi	Yes	Yes
The ones for selling. Goes to the market in Nairobi 3 times a week (uses public transport).	Cabbage and potato for marketability	All of them	Coriander. Fast growing + marketability
-	No seasons, but planned rotation system	-	Carrots and potatos in the wet season; no coriander during the rains.
He plants crops after market patterns. He is the only one in the area growing the crops he is growing. Takes advantage of that.	No particular influences. Soil quality is the same on whole plot	-	Season is the most important factor, because the market changes according to it
-	N/A	Intercropping because of limited space. Would grow monoculturally if he had more space	Crops that need more water are placed closer to the well (observation: there is some slope on the plot, and during a walk on the shamba it turns out that they do grow different crops in certain places because of this)
for commercial purpose (they are sold in the market in Nairobi to the Chinese and Indians). Buys crops for own consumption from the income from	Mainly for selling	Subsistence	Both (observation/derived from further talks: market more than HH needs)
-	Potato, as it can be used for many different meals	-	-

If he was to start growing a new crop he would go to the market in Nairobi to see demand. He gets seeds from the Chinese and Indians.	It's out of the question to try a new crop	Beetroot, for selling and eating, fast-yielding. + a neighbour has positive experiences marketing it.	Yes. Herbs and spices, tree tomatoes and strawberries. All for commercial purposes, and inspired by friends in other regions.
-	N/A	-	Insecure about how they will perform in this specific climate.
The main problem is water. The access is there (he has a borehole and enough water to irrigate the entire area. Use propella) but it is difficult to distribute bacuse of his age. Another problem is keeping up with demand. Teaches other farmers in the area to grow the crops he grows.	Frost. Fluctuating weather conditions.	-	Drought. Depending on the well (?). Also P&Ds
	Agro-vets. Has heard of presence of some trainees, but don't know where they come from.	-	The AEO! She interacts a lot with the ministry, goes there and calls them. "They're nice people and they even pass by". "Farmest ant to be independent and don't want to look for advice. Hence the MoA is reluctant to enter onto farmers' lands without permission.
-	Yes	Yes. About livestock.	-
-	Quite good	Good (knows based on yields)	Good. Tells from the yield.
more fertile. Prefer cow manure over sheep manure. Retains water better.	compost, manure, all of it.	No fertiliser, but always manure and lots of it.	fertiliser. Interested in organic farming, mainly because of health issues. Learned about
A production decrease has occurred. Caused by overproduction. He leaves some acres not cultivated to increase soil fertility.	No [perceived] change in 20+ years	-	-

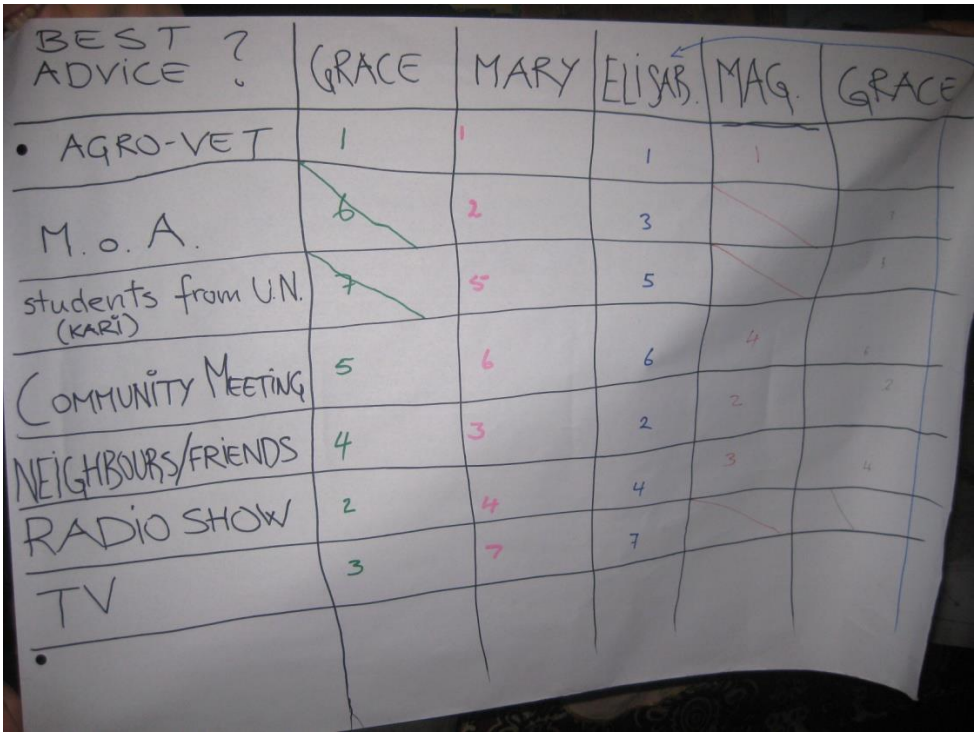
		-	
	Yes	-	-
1,5 acre	0.5 acre	1/4 acre (observation: seems to be even less!)	1.5 acres
-	-	- (observation: no!!!)	"Not so big, but we manage"
-	no	no	and avocado. The family goes there approx. once a month,
-	no	no	Not anymore.
He attend Field Days. Prefer doing practical learning over theoretical. Goes to International Tradefair. He learns from this.	Radio: "Mugambo wa murimi" (The voice of the farmer). TV.	Neighbours, radio (mukuilma), tv	AEO (see above answer). Internet (own research - serendipity). Books ("The seeds of gold"). Friends across the country + internationally who are also farmers, and even university lectures.
Does research and goes to farmers and teach how to plant the species he grows.	Agro-vets	(see above)	
-	-	Has talked with KENVO about bee-keeping and agro-forestry, but it didn't seem very serious. Says MoA is not important, and is never in contact	Quite often
He notes that the AEO only goes to see specific farmers. He thinks they should go to see all farmers.	-	-	Mainly seeks them out, but sometimes they visit
-	How to apply fertilisers	Agro-vets provide knowledge about poultry and sheep	-
-	Yes	-	yes
-	Agro-vets	Agro-vets	Internet sources confirmed through friends + AEO
-	-	-	trust them. They're the last people I would go
Teach other farmers to grow what he grows to be able to meet the demand from the market in Nairobi.	-	-	yes
-	-	-	-
-	-	No, it's far from sufficient.	Sometimes yes. "The biggest factor is whether I've been around to tend to the crops myself". Has noted changes for the worse due to global warming.
	Kenvo services only benefit its members	He has zero agricultural training	Has worked with KENVO, which has also sparked an environmental interest.
	present during interview	overcrowded by children and animals. Farmer	Orderly, spacious and well-kept. Stone house, bio-gas, the whole bit. Everyone speaks perfect

Appendix V: PRA: Photos of Drawings

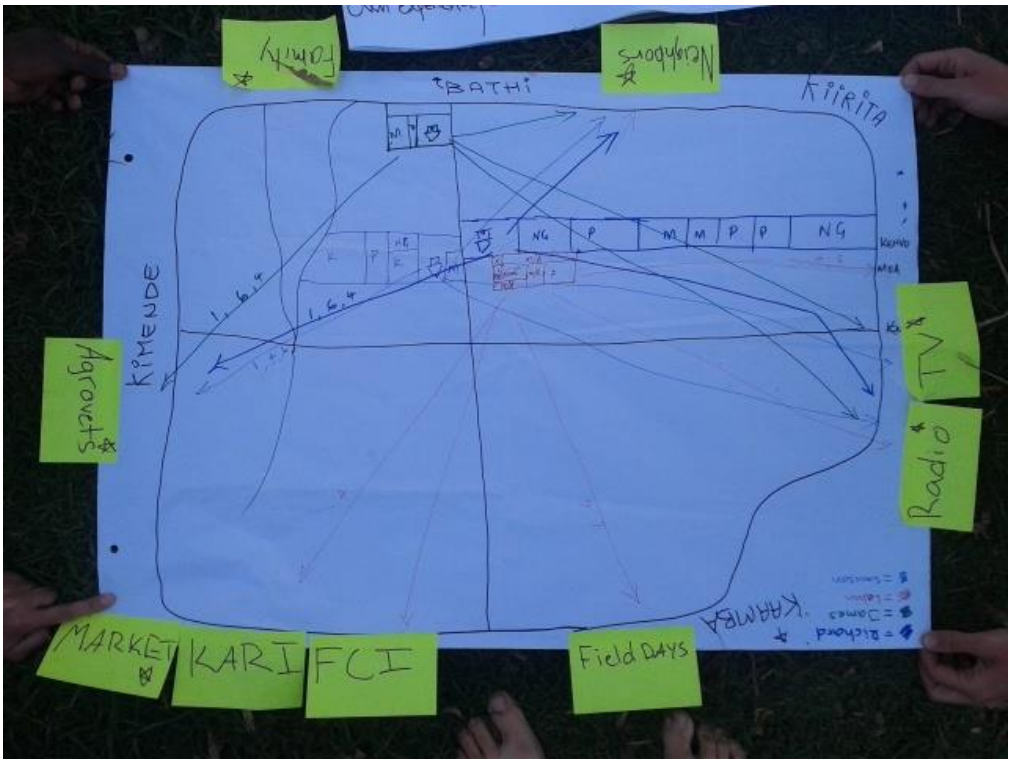
Women's cultural mapping w/ indications on where they go for advice



Women's ranking of sources of knowledge (one being the most important)



Men's cultural mapping w/ indications on where they go for advice



Men's ranking of sources of knowledge (one being the most important)

	Laban	James	SAMSON	Richard
Kenvo				
Agrovets	7	1	2	2
Field days	2		6	
KARI	5			
Neighbors	8	4	4	4
MoA	3		5	
TV/Radio	4	2	1	3
FCI	1			
Own experience	6	3	3	1

Appendix VI: Raw Data from the Soil Lab

ID		Sample name	Weight g (C/N)	Bulk density
1	north	Neighbour to nancy warimu	0,047	
2	north	Nancy Warimu	0,058	
3	north	Bernard sample 1	0,054	
4	north	Bernard sample 2	0,056	
6	south	Mama Caro (near)	0,060	
5	south	Mama Caro (far)	0,053	
7	south	Washera I	0,052	
8	south	Washera II	0,053	
9	south	David I	0,054	
10	south	David II	0,056	
11				
12	north	Farmer 4a		76,3
13	north	Farmer 4b		74,0
14	north	Farmer 3a		72,9
15	north	Farmer 3b		79,7
16	south	Test a (baba Munio)		68,6
17	south	Test b (baba Munio)		83,5
18	north	Farmer 6a		73,3
19	north	Farmer 6b		69,8
20	north	Farmer 8a		75,0
21	north	Farmer 8b		78,2

C/N results			pH measurements	PoxC = absorption value
C (%)	N (%)	C/N ratio		(actual permanganate
3,86	0,37	10,43243243	5,25	0,01
5,84	0,58		5,9	0,0046
4,95	0,41		6,15	0,0087
5,56	0,49		6,8	0,0053
5,69	0,53		6,6	0,005
5,57	0,54		6,58	0,005
4,25	0,41		7,08	0,0087
5	0,5		6,52	0,007
5,15	0,51		6,91	0,005
4,16	0,43		6,26	0,0107
			5,63	0,00466
			n/a	n/a
			4,64	0,00766
			5,1	0,011
			5,2	0,00466
			5,5	0,008