universität wien

DIPLOMARBEIT

Titel der Diplomarbeit

„The Influence of Social Opportunity Networks on Adaptive Capacities of Small-scale Agro-pastoralists in the Context of Climate Variability and Change -

A Case Study from Laikipia District, Kenya“

Verfasserin

Agnes Sophia Zehrer

angestrebter akademischer Grad

Magistra (Mag.)

Wien, 2012

Studienkennzahl lt. Studienblatt:	A 057 390
Studienrichtung lt. Studienblatt:	Individuelles Diplomstudium Internationale Entwicklung
Betreuerin:	Priv. – Doz. Dr. Maria Wurzinger

TABLE OF CONTENTS

Acknowledgements

Many people have - directly or indirectly - contributed to this work. Without them, I could never have accomplished it and I am very grateful for their support. So a huge “Thank You”, “Asante Sana” and “Dank’ Schea” goes out to my supervisors, supporters, collaborators, friends and family.

First and foremost I would like to thank my supervisor Priv. – Doz. Dr. Maria Wurzinger for all her prompt feedback, for her great availability and above all, for her interest and trust in my research. Maria kept supporting me with helpful comments and constructive criticism on my work and she always found the right balance between letting me go my own way and bringing me back onto the right track when necessary.

Much gratitude goes to my other supervisor, Dr. Michael Hauser, for giving me the chance to write this diploma thesis within the institutional framework of the Centre for Development Research (CDR) at the University of Applied Life Sciences (BOKU), Vienna. He also assisted me throughout the research process and consistently gave me valuable food for thought.

Most heartfelt thanks to M.Sc. Sarah Ogalleh Ayeri. Without her, this work would not exist. Sarah greatly helped me during my field research in Kenya with access to the field, with data collection, with facilitating the group discussions and many other things regarding this research. Even more important, Sarah gave me a home in Kenya, in the truest sense of the word. “Asante so seriously sana, sister” for incorporating me into your life and for introducing me to a very unique Kenya.

Further, I want to thank B.Sc. Jackson Waiganjo Wachira for assisting me with translating and transcribing hours and hours of recorded interviews until we got the nickname “Umande fm”. Jack patiently provided me with invaluable background knowledge and I cherish all the interesting discussions I had with him.

Another big “thank you” goes to M.A. Paul Roden who always had a sympathetic ear for my troubles during the research process and who was a source of inspiration and motivation for me.

Dr. Eva Schiffer introduced me to the secrets of the research method “Net-Map” and helped in a methodological emergency. I am very grateful for all her support and advice.

Thanks to M.Sc. Barbara Noske for being interested in my thoughts, for listening to my problems and for doing the unnerving proof-reading of the work in the end - this all meant a lot

to me. At this point I also want to thank all my friends who patiently followed the progress of my work and who cheered me through.

Special thanks go to all my interview partners from Umande sub-location in Kenya for sharing their insights, observations, knowledge and precious time with me. I learnt a lot from them - not only about their lives and hardships - and I have great respect for them. At this point I want to thank Mr. Dominic Wahome who, with great enthusiasm and reliability, helped organizing the group discussions. Thank you so much to all my expert interview partners who gave me additional insights and a general understanding of the situation.

Much gratitude goes to the Center for Training & Integrated Research in Arid and Semi Arid Lands Development (CETRAD) in Nanyuki, Kenya, which greatly supported this study by allowing me to use their research facilities and services. At this point I want to specially thank Mr. Dennis Ojwang for the compilation of maps and Mr. Joseph Ndung'u for his help to organize the expert interviews.

I also want to express my thanks to the University of Vienna for funding this study through its research support scheme "Förderstipendium".

My biggest thanks I have to give to my 'base camp' though, which kept providing me all these years with backing, with courage, with food and with vital moral support whenever I faced setbacks. THANK YOU to my brother Max for exploring (im)possible routes and accompanying me on a rough ascent as if it was the most natural thing in the world. And THANK YOU to my parents for enabling me to conquer any mountain or comparable barrier.

1 Introduction

1.1 Preliminary thoughts

1.1.1 Background of the study

Climate variability and change and their impacts on societies and nations are highly debated these days. The majority of the global poor depend directly on agriculture and on natural resources, both of which are highly sensitive to changes in the climatic conditions (IISD 2003: 13). According to the International Fund for Agricultural Development (IFAD 2011), 70 per cent of the world's very poor live and work in rural areas (IFAD 2011a: 16). Where climate variability and change result in the absence of annual rains, in droughts or in floods, crop failures and livestock deprivations occur more frequently, posing a serious threat to the livelihoods of the rural poor. "Over 80 per cent of rural households farm to some extent, and typically it is the poorest households that rely most on farming and agricultural labour." (IFAD 2011a: 16) There is a broad consensus that especially the poor are facing the most serious problems as they are perceived to have the lowest capacity to adapt to climate variability and change. The lack of essential financial, social and technological resources hinders sustainable adaptive processes and makes the poor most vulnerable to climate-induced stresses and shocks.

This study has been carried out as a part of M.Sc. Sarah Ogalleh Ayeri's doctoral thesis on agricultural adaptations of smallholders to climate variability and change in Laikipia District, Kenya. According to the Food and Agriculture Organization of the United Nations (FAO 2011), 30 per cent of Kenyans are undernourished notwithstanding that Kenya is one of the best developed economies in eastern Africa (FAO 2011: 44). Furthermore, the World Bank (2011) reports that 4 out of 5 Kenyans depend on agriculture for their livelihoods (World Bank 2011: 77). Local smallholders in Laikipia District are increasingly facing droughts and other exceptional climatic conditions which make crop cultivation and animal husbandry difficult and endanger their livelihood securities. In 2009, a severe drought ravaged the area, most of the smallholders' crop yields were destroyed and thousands of their animals died. In 2011, due to prolonged dry spells during the rainy season, the smallholders' crops and livestock were again affected by high losses. The small-scale farmers in the area have consistently been depended on relief food provided by the Kenyan government. Consequences of climate variability and change might in future aggravate the smallholders' dependency on state aid.

1.1.2 Research interest

The question arises whether adaptive capacity can be fostered despite the deprivation of essential resources, assets and skills. While it is clear that a holistic examination of adaptive capacity to climate variability and change would necessarily demand the analysis of all assets, resources, skills, capitals, etc., their inclusion would be beyond the scope of the study at hand. Rather, the decided examination of social capital formed the basis for this study, especially since social capital is often described as a "resource of last resort for the poor and vulnerable" (DFID 1999: 9). This study concentrates in particular on social networks as a form of social capital. Other aspects of social capital like norms and trust will not be considered here. Do social networks of small-scale farmers, respectively the possibilities they have for social networking, influence their adaptive capacities? And if so, how do they influence adaptive capacities? Can network opportunities help smallholders to cope with climate-induced stress and shocks? Or do certain social network structures hinder adaptations to climate variability and change by their structure or arrangement?

1.2 Research question, working hypothesis and objectives

1.2.1 Research question

Following considerations about reducing smallholders' vulnerabilities to climate-induced stresses and shocks and enhancing their adaptive capacities to climate variability and change, the research question underlying the research process is:

"How do social opportunity networks (i.e. social networks and network opportunities) influence the adaptive capacities of small-scale agro-pastoralists on the Laikipia plateau in the context of climate variability and change?"

In order to answer the research question three subsequent questions have been formulated:

1. How do the social opportunity networks of the smallholders regarding agricultural practices look like in the study area and how are they structured?

2. How do these social opportunity networks influence decision and eventually concrete adoption of agricultural practices in the study area?

3. How do these networks enhance or erode the adaptive capacity of the smallholders to climate variability and change in the study area?

1.2.2 Working hypothesis

The working hypothesis which shall be tested in this study is:

"The adaptive capacity to climate variability and change is higher amongst small-scale agro-pastoralists who use more formalized social networks than among those who use rather informal social networks."

1.2.3 Objectives of the study

The overall goal of this study is to add to the insights about the role of social opportunity networks in influencing the smallholders' adaptive capacity in the context of climate variability and change in Laikipia District, Kenya.

The main objectives herein are:

1. To describe how the social opportunity networks of the smallholders regarding their agricultural practices look like in the study area and how these opportunity networks are structured.

2. To explain how the smallholders' social opportunity networks influence their decision and eventually concrete adoption of agricultural practices in the study area.

3. To illustrate how these networks may enhance or erode adaptive capacity of smallholders to climate variability and change in the study area.

1.3 Outline of the study

The study is organized into five major sections. Following the introduction of Chapter 1, Chapter 2 presents a literature review of sociological approaches to the concepts of climate variability and change, of vulnerability and of adaptive capacity as well as of social capital and social networks. Chapter 3 describes the research methods. In order to be able to answer the research question, a field study in Laikipia District, Kenya was conducted (July – September 2011). The methodology therefore includes a description of the study site, of the research partners and of the data collection process. It further displays the data processing and the data analysis. The data was analyzed using a combination of descriptive statistics and qualitative interview analysis which was specifically developed for this study as established methods on qualitative analysis of social networks are scarce. Chapter 4 presents the results which the empirical analysis of the social

network opportunities of small-scale farmers in Laikipia District generated. It concurrently discusses how these results might enhance or erode the adaptive capacity of the smallholders in the context of climate variability and change. Chapter 5 concludes by shortly summarizing the overall findings. It also reflects on possibilities which further research on social networks could offer in this context and gives policy recommendations following the results of this study.

2 Literature Review

2.1 Climate variability and change

2.1.1 The concepts of climate variability and change

There is a lot of literature on climate variability and change nowadays, but the debates about causes and impacts of climate change keep going on. Since the terms "climate change" and "climate variability" are repeatedly being used on the following pages, they will be shortly defined here. The differentiation between climate variability and climate change has been made in this study since there is, on the one hand, no more doubt about the reality of climate change, but on the other hand, the climate phenomena observed and experienced by people are usually related to climate variability. In this sense climate variability refers to short-term variations in climate (seasonal, annual, or within several years) and includes phenomena like El Niño and La Niña or other extreme events such as droughts, storms and floods. Climate change, however, refers to long-term trends in the mean climate (over decades or centuries) and to long-term changes in climate variability (i.e. the frequency, intensity and duration of extreme events).

Climate change

The understanding of the term "climate change" here is adopted from the definition by the Intergovernmental Panel on Climate Change (IPCC 2007):

> Climate change in IPCC usage refers to a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity. This usage differs from that in the United Nations Framework Convention on Climate Change (UNFCCC), where climate change refers to a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods. (IPCC 2007a: 30)

Climate variability

Likewise, the following definition of "climate variability" by the IPCC (2007) is applied to this study:

> Climate variability refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all spatial and temporal scales beyond that of individual weather events. Variability may be due to natural internal processes

> within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability). (Christensen et al. 2007: 944)

After years of intense discussions, the IPCC (2007) states that "[w]arming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level." (IPCC 2007a: 30) Today, there is a widespread consensus that the earth is experiencing the largest and fastest warming process which science has detected in recent global history. It is also widely agreed that *at least parts* of the causes for the increase in temperature, which we are experiencing now, are anthropogenic. Human development along with its enormous global industrialization is believed to have led to exceptionally high greenhouse gas emissions, which, in turn, have changed the chemical composition of the atmosphere and thus contributed to global warming (Christensen et al. 2007, UNDP 2007, UNFCCC 2007). It is anticipated that the mean global temperature will continue to rise at a rate between 2 and 4 °C within the next century.

> The main impacts of climate change will however not be felt through higher temperatures but through a change in the hydrological cycle. Not only the average annual or seasonal rainfall will change; there will also be an increase in the number of extreme events resulting in more frequent and severe floods and droughts. (Ludwig et al. 2007: Executive Summary, cp. Christensen et al. 2007)

Discussions keep going on about the actual rate at which climate will change as well as about the specific impacts that climate change will have especially on regional scales. For various reasons it is difficult to predict how climate will exactly change in different regions. This is mostly

> because of incomplete understanding of the climate system (e.g. the unknown value of the climate sensitivity, different climate model responses, etc.), [and] because of the inherent unpredictability of climate (e.g. unknowable future climate forcings and regional differences in the climate system response to a given forcing because of chaos). (Hulme et al. 2001: 152)

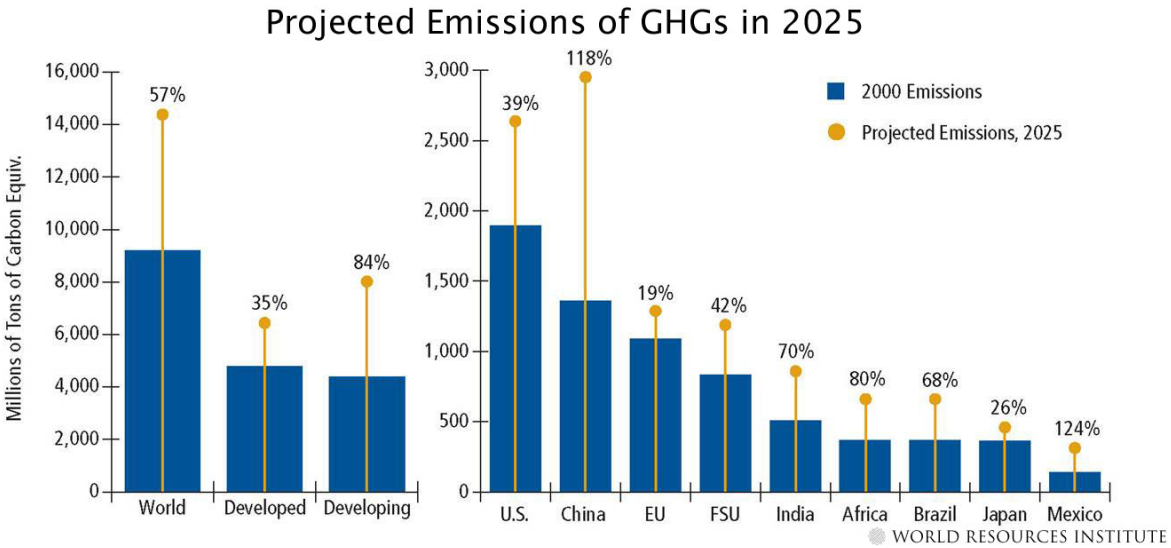
Furthermore, for many regions it is difficult or impossible to get current climate data and climate data reaching back in history due to a lack of monitoring stations, of their handling and of their maintenance (UNFCCC 2007: 13, Ludwig et al. 2007: 3). Similarly, the specific impacts of climate change which are already occurring cannot always be monitored, particularly on a regional basis. Adding to that, it is highly controversial whether an observed phenomenon is a consequence of climate change or not. Future impacts are hard to predict as there are several influencing factors which are unforeseeable and which might or might not be connected with climate change. In addition, many impacts are transferred and do locally not occur where they have come into existence.

> With some greenhouse gases remaining in the atmosphere for centuries, historical emissions have guaranteed the inevitability of climate change for several decades, regardless of policy responses. And the burden of impacts is likely to be most serious in developing countries, even though they

have contributed little to historical emissions. This imbalance of responsibility for the current causes of climate change and its impacts creates an enduring global inequity. While the economies of developing countries such as China and India are growing rapidly, leading to greater energy use and higher living standards, other countries cannot afford national electricity grids, much less energy-intensive luxuries." (Dow/ Downing 2006: 39, see also UNDP 2007:3)

Projections of the World Resources Institute (WRI 2005) for 2025 suggest that greenhouse gas emissions will continue to rise strongly if no action for mitigation is taken. Traditional major emitting countries (USA, China, EU, Former Soviet Union [FSU], India) are likely to keep dominating emissions while emissions from developing countries are likely to rise more rapidly (Baumert/ Herzog/ Pershing 2005: 18).

Figure 1: Projected emissions of greenhouse gases by 2025



Notes in source: "Projections are based on EIA, 2003 (reference case, CO2 from fossil fuels) and POLES (non-CO2 gases) (EC, 2003). GHGs do not include CO2 from land use change. 'FSU' is former Soviet Union." Source: Baumert/ Herzog/ Pershing 2005: 18

But wherever the greenhouse gases are emitted, they will have the same impact on the global climate – only the effects will differ around the world. "Climate change will have wide-ranging effects on the environment, and on socio-economic and related sectors, including water resources, agriculture and food security, human health, terrestrial ecosystems and biodiversity and coastal zones." (UNFCC 2007: 8) The effects are assumed to hit the poorest countries the hardest because they are the least able to adapt to climate variability and change.

2.1.2 Climate change in East Africa

Signs of climate change in East Africa have become visible in different places. “Because glaciers respond to temperature trends, rather than to single warm years, they provide valuable evidence of long-term change.” (Dow/ Downing 2006: 24) Easily observable is the rapid shrinking of the small remnants of glaciers on top of Mount Kenya and of Mount Kilimanjaro. “Over the past century, the glaciers of Mount Kenya have lost 92 per cent of their mass, and the volume and extent of this loss has greatly accelerated in recent years.” (IFAD 2011b: 3) With this trend continuing, the glaciers are expected to have vanished by 2025 and with them important freshwater reservoirs for the regions (Dow/ Downing 2006: 24). Another sign of climate change on the East African continent is the accumulation of droughts in the Horn of Africa over the past 50 years (IFAD 2011b: 3). The most recent droughts which the region has experienced occurred in the years 2006, 2009 and 2011 due to consecutive years of failing rains which lead to severe food shortages (cp. Dow/ Downing 2006: 21).

For East Africa a further increase in the mean annual temperature is expected (ranging between 2 and 6 ˚C over the next 100 years, cp. Christensen et al. 2007: 868) and at the same time an increase in the mean annual precipitation (Christensen et al. 2007: 869, cp. Moore et al. 2012, Hulme et al. 2001). “While these predictions of future *warming* [emphasis in original] may be relatively robust, there remain fundamental reasons why we are much less confident about the magnitude, and even direction, of regional *rainfall* [emphasis in original] changes in Africa.” (Hulme et al. 2001: 165) Climate in East Africa is highly variable at the local level since it is influenced by complex equatorial circulations, by the El Niño/ Southern Oscillation (ENSO), by the Indian Ocean (Sea Surface Temperatures) and by a highly diverse regional topography (ranging from sea level along the coasts and the African Rift Valley to large continental volcanoes and expansive inland lakes) (Moore et al. 2012: 825, Hulme et al. 2001: 165). Moore et al. (2012) further state that “Land Cover and Land Use Change (LCLUC) alter surface albedo which in turn may influence local and regional climate dynamics. […] Besides GHG [greenhouse gases, author’s note], LCLUC is also a primary driver of climate change at local to - in some cases - much larger scales.” (Moore et al. 2012: 825)

“[T]he increase in the number of extremely wet seasons [is likely to come] to roughly 20% (i.e., 1 in 5 of the seasons are extremely wet, as compared to 1 in 20 in the control period in the late 20th century).” (Christensen et al. 2007: 871) The anticipated higher rates of mean precipitation in Eastern Africa do not necessarily imply an easing of water stress in the region. They might as well originate from an increase in extreme climate events like heavy rains and floods in

combination with long dry spells. It can be concluded, that aside from a general increase in the mean temperature and in the mean annual precipitation in East Africa, an increase in extreme climate events such as droughts and heavy rains is anticipated. It remains to be seen though how climate will change in particular.

2.1.3 Climate change impacts on East Africa

While, on a global scale, African countries are still among those accounting least to annual greenhouse gas emissions, they will probably be among those suffering most from the expected effects. On a regional scale, little is known about climate change and its impacts. Possible future impacts and effects for East Africa and especially for the study area can only be gathered from more general assumptions about the impacts of climate change on Africa. The major problems are likely to arise from threats to water supplies, to food security and to human health. "The water sector is strongly influenced by, and sensitive to, changes in climate (including periods of prolonged climate variability)." (Boko et al. 2007: 437) The study area of this research being located on a semi-arid high plateau on the western slopes of Mount Kenya in Eastern Africa, the following findings by the IPCC (2007) for entire Africa could probably be assigned to it:

> There is also high confidence that many semi-arid areas […] will suffer a decrease in water resources due to climate change. Drought-affected areas are projected to increase in extent, with the potential for adverse impacts on multiple sectors, e.g. agriculture, water supply, energy production and health. Regionally, large increases in irrigation water demand as a result of climate changes are projected. […] Available research suggests a significant future increase in heavy rainfall events in many regions, including some in which the mean rainfall is projected to decrease. The resulting increased flood risk poses challenges to society, physical infrastructure and water quality. […] Increases in the frequency and severity of floods and droughts are projected to adversely affect sustainable development. (IPCC 2007a: 49)

Indeed, the already existent stresses on water resources in the research area (cp. "3.1.2. Site description") are likely to be worsened by effects of climate change. The changes in precipitation, the melting of the ice caps on Mount Kenya, the rise in temperature along with a growing likelihood of droughts and prolonged dry spells in semi-arid regions are expected to exacerbate severe problems of water scarcity due to rapid socio-economic change. Agricultural production, including access to food, is at the risk to be compromised:

> The agricultural sector is a critical mainstay of local livelihoods and national GDP in some countries in Africa. […] [Often, farmers] have to contend with other extreme natural resource challenges and constraints such as poor soil fertility, pests, crop diseases, and a lack of access to inputs and improved seeds. These challenges are usually aggravated by periods of prolonged droughts and/or floods and are often particularly severe during El Niño events. (Boko et al. 2007: 439)

2.2 Vulnerability and adaptive capacity

2.2.1 Vulnerability

For a full understanding of the connection between climate variability and change and adaptive capacity it is necessary to shortly introduce the concept of vulnerability. The term vulnerability is usually used to describe a "condition of susceptibility shaped by exposure, sensitivity and resilience" (IISD 2003: 6). In this sense vulnerability to climate change "is the degree to which systems are susceptible to, and unable to cope with, adverse impacts" (IPCC 2007: 48). Kelly and Adger (2000)

> […] define vulnerability in terms of the ability or inability of individuals and social groupings to respond to, in the sense of cope with, recover from or adapt to, any external stress placed on their livelihoods and well-being. Implicit in this definition of vulnerability is the adoption of the 'wounded soldier' perspective in focussing attention on constraints, 'wounds', that limit the capacity to respond to stress effectively and that exist independent of the future threat. (Kelly/ Adger 2000: 328)

The 'wounded soldier' perspective is very important in this context as it explains why especially the poor are most vulnerable to climate variability and change. They are already 'injured' and therefore less able to cope with any new threat.

> Poverty, more than any other factor, determines vulnerability to climate change and limits adaptive capacity. Access to and control over land, money, credit, information, health care, personal mobility, and education combine to determine the ability to survive and recover from disasters and to make long-term changes and investments to adapt. Existing gender inequalities combine with poverty to magnify women's vulnerability to climate change and undermine their ability to adapt. (Pettengell 2010: 3)

But as McNeeley concludes, "vulnerability is not a 'state' but rather a set of complex interacting social-ecological variables and conditions that are dynamic and continually changing based on both internal and external dynamics in any point in time." (McNeeley 2009: 8) It can therefore be influenced and changed by reducing exposure, by reducing sensitivity and by enhancing adaptive capacity.

2.2.2 Adaptive capacity

The concept of adaptive capacity is in many research fields closely related to the concept of vulnerability. Adaptive capacity in the context of climate variability and change refers to "the capacity of a system to adjust practices, processes or structures to moderate or offset the potential damage or take advantage of the opportunities created by a given change in climate." (Eriksen/ Naess 2003: 4) Despite there being numerous different definitions, the latter definition

provides a background for this research. With the Sustainable Livelihoods Framework (DFID 1999) a tool was introduced that helps to understand which assets people have at hand to sustain their livelihoods and how they will probably respond to climate-induced stresses and shocks. These livelihood assets include financial capital, physical capital, natural capital, human capital and social capital. The Sustainable Livelihoods Framework has great explanatory power and has often been used as a basic principle for adaptive capacity. It is important to recognize though that adaptive capacity is not only conveyed in the assets that people have which enable them to adapt, but also in the way they use these assets in order to improve their resilience. Therefore another framework especially for adaptive capacity has been developed by Jones/ Ludi/ Levine (2010), the Local Adaptive Capacity (LAC) framework. There are some advantages of this concept: First of all, "[…] it is currently *not feasible to measure adaptive capacity directly* [emphasis in original]. Instead, LAC is based on an analysis of the characteristics that contribute to the adaptive capacity of a system" (Jones/ Ludi/ Levine 2010: 2). Secondly, unlike traditional frameworks which tend to analyze adaptive capacity solely on the basis of assets and capital, the LAC also tries to incorporate supportive processes and functions for adaptive capacity. Especially in the context of social networks it is important to not only look "[…] at what a system has that enables it to adapt, [but also] what it does to enable it to adapt" (Jones/ Ludi/ Levine 2010: 1). Thirdly, the LAC puts a focus on the local level "[…] recognizing that, while much of the attention has so far been given to developing characteristics and indicators on the national level, little research has been done on adaptive capacity at the community or household level" (Jones/ Ludi/ Levine 2010: 2). The Local Adaptive Capacity framework "[…] identifies five *distinct yet interrelated* [emphasis in original] characteristics that are conducive to adaptive capacity. These are: the asset base, institutions and entitlements, knowledge and information, innovation, flexible forward-looking decision-making" (Jones/ Ludi/ Levine 2010: 3).

The theoretical concepts of the presented frameworks have greatly influenced the understanding of adaptive capacity in this research. Further, research about adoption and social learning processes, about agricultural innovation and knowledge management has contributed to the understanding of adaptive capacity. There is evidence that "[…] social learning leads initial adoption decisions to be correlated within social networks. This sheds light on which individuals are the first to adopt a new technology, which in turn, affects its diffusion." (Bandiera/ Rasul 2006: 869) Concerning knowledge, Hartwich et al. (2007) found that "[…] knowledge management schemes that involve multiple agents from the public and private sector, as well as from civil society, enhance positively farmers' attitudes towards innovation." (Hartwich et al.

2007: 22) In the light of adaptation to climate variability and change, social learning, knowledge management and innovative power play essential roles for farming communities.

2.3 Social capital and social networks

2.3.1 Social capital

Social capital is regarded as one of the decisive features in research about adaptive capacity. It has therefore been incorporated into both, the Sustainable Livelihoods framework and the Local Adaptive Capacity framework. The concept of social capital is grounded on works by the sociologists Bourdieu (1983), Coleman (1988) and Putnam et al. (1993). Especially Bourdieu's and Coleman's analyses concentrated on individuals and small groups (families) and their benefits deriving from their ties with others (Portes/ Landolt 2000: 531). The concept was further developed by other researchers and in an early definition, social capital was described as "(1) a source of social control; (2) a source of family-mediated benefits; and (3) a source of resources mediated by non-family networks." (Portes/ Landolt 2000: 531) Putnam introduced a nowadays widely acknowledged definition of social capital as: "Features of social life – networks, norms and trust – that enable participants to act together more effectively to pursue shared objects." (Putnam 1995, cited in Pelling/ High 2005: 310)

Social capital in this study is understood as "the relationships and social networks, agreements, flows of information and features of social organization such as trust, norms, and networks that can facilitate coordinated actions to achieve social benefits and facilitate well-being and security." (Adger et al. 2004/ Fukuyama 2003, cited in McNeeley 2009: 12)

2.3.2 Social networks

Beside the inflationary use of the term social networks in connection with online services in the World Wide Web today, social networks usually exist in non-virtual relationships between people, groups or organizations. Their relations are typically expressed in links such as the exchange of information or resources, money, social contacts, political influence etc. Like in many other studies, social networks are seen here as an integral part of social capital. But as Lyon (2000) remarked, "[…] the distinction between what *causes* [emphasis in original] social capital and what it actually *is* [emphasis in original], cannot be made. Social capital comes from

the interplay of a range of factors that shape how agents react and these reactions are shaped by existing social capital." (Lyon 2000: 664) Following Dalton et al. (2002) social networks are defined by Hoang, Castella and Novosad (2006) as "[…] mechanisms that connect individuals to society, providing patterns of social interaction, social cues and social identities." (Dalton et al. 2002, cited in Hoang/ Castella/ Novosad. 2006: 514) In his brief overview on network analyses in social sciences, Diaz-Bone (2006) states that

> Soziale Netzwerke stellen Ressourcen (verschiedene Kapitalformen) für Akteure bereit, organisieren Kollektive und machen sie handlungsfähig bzw. schränken ihre Handlungsfähigkeit ein. Netzwerke stellen Infrastrukturen für Austausch- und Kommunikationsprozesse zwischen Individuen, Gruppen und Organisationen dar. Durch Netzwerkbeziehungen werden Handlungsorientierungen (Normen) erworben und sanktioniert. (Diaz-Bone 2006: 4)

Social networks can thus enhance social capital but they can also erode it. On the one hand, social networks can provide individuals and households with information and economic resources. This is why they are often seen as crucial for "[t]he rural poor, whose productive assets and human capital are often minimal at best and who have little institutional support to draw on, social networks act as a safety network and an important means to gain access to other resources." (Hoang/ Castella/ Novosad 2006: 514) Networks create a number of other benefits for their members such as advocacy to influence policy or public debates, work division, partnerships and collaborative learning, among others. While networks have many different objectives, the practice of networking is often considered their main objective (UNDP/ UNSO 2000 in Hulsebosch/ Marcilly/ Schaeffers 2006: 34). On the other hand, Lyon warns of "the danger of taking a romanticized view of networks, or 'the community' […] [because] civil society is an arena for social contestation in which power struggles exist and affect which groups control which resources and what they do." (Lyon 2000: 665) Membership in social networks is usually associated with trust and reciprocity. Since the poor and powerless have little to offer, their ability to maintain and strengthen social networks is insecure (Hoang/ Castella/ Novosad 2006: 514). This, in turn, may lead to further erosion of their social capital. The inclusion in and exclusion from certain groups and networks is an important issue for increasing social capital. Depending on specific ties, members of certain groups might "[…] be restricted in participating in wider networks because of community obligations", for example (Lyon 2000: 665).

2.3.3 Social network analysis

Social network analysis is a theoretical and methodological approach of social science which has evolved in the United States of America at the end of the 1970s. It grounds on sociologic and

anthropologic research on social networks and has since the 1960s incorporated a strong mathematical component. Social network analysis has developed a broad range of techniques, methods and theories since, including methods for survey and evaluation, statistical measures, software programs and network theories. The main contributions to this field of social science research, which is nowadays established as traditional Social Network Analysis (SNA), still come from the USA. Traditional social network analysis has a distinct focus on the structure of relationships between people, groups or organizations. The three main levels of analysis are usually

> (a) Eigenschaften der Knoten (d.h. Eigenschaften von Akteuren, von Organisationen, aber auch von Ereignissen), diese sind attributionale oder kategoriale Eigenschaften.
>
> (b) Eigenschaften der Beziehungen (wie bspw. Stärke, Symmetrie/Asymmetrie, Multiplexität, Transitivität usw.), diese sind relationale Eigenschaften.
>
> (c) Eigenschaften der Netzwerkstruktur (Dichte, Verbundenheit, Differenzierung in Teilnetze, Heterogenität der Knoten usw.), hierbei handelt es sich nun um die Struktureigenschaften also um Eigenschaften der Netzwerke selbst. (Diaz-Bone 2006: 5)

Forms of network analysis differentiate between ego-centric networks and full networks. While the former concentrates on one individual and his/ her connections to other actors, a full network analysis requires that all information about each actor's ties with all other actors is collected. Most of the available research and literature of formal SNA concentrates on structural and statistical analyses of social networks using quantitative methods. This pure structure-driven approach of formal network analysis has since the 1990s repeatedly been criticized and lately a new field of analyzing social networks with qualitative methods has been emerging. A recent study found out that literature and methods about qualitative methods in the field of social network analysis are scarce:

> Gemeinsam ist allen untersuchten Lehrbüchern, dass sie sich mit statischen Netzwerken beschäftigen, nur fünf der Bücher gehen auch auf jüngste Trends ein und beziehen dynamische Netzwerke in ihre Erläuterungen mit ein. Demzufolge enthalten auch rund 80% aller Lehrbücher quantitative (empirische) Methoden, bis auf das sich explizit auf qualitative Vorgehensweisen fokussierende Werk von Hollstein und Straus (2006). Bis auf eine Ausnahme (Schweizer 1996) beschäftigen sich alle Bücher mit Gesamtnetzwerken und behandeln egozentrierte Netzwerke entweder nur sehr am Rande oder gar nicht. […] In keinem der zur Zeit zur Verfügung stehenden Bücher wird der konkrete Forschungsablauf in seiner zeitlichen Abfolge mit den konkreten Schritten der Datensammlung, -aufbereitung und -analyse behandelt. (Mergel/ Hennig 2010: 937)

Following critique on traditional SNA in its dealing with actors, agency and structure, Hollstein (2010) states that qualitative methods hold distinct advantages for social network analysis.

> Bei den Einsatzmöglichkeiten im Rahmen der Netzwerkforschung unterscheide ich sechs Aspekte, für deren Untersuchung qualitative Verfahren besonders geeignet sind: für die Exploration von Netzwerken, die Untersuchung von Netzwerkpraktiken, von

> Netzwerkinterpretationen, von Netzwerkwirkungen und von Netzwerkdynamiken sowie für den Zugang zu bestimmten Akteuren und Netzwerken. (Hollstein 2010: 460)

More precise, Hollstein (2010) favors combinations of qualitative and more standardized, quantitative methods, so-called 'Mixed-Method-Designs'. For the study at hand a qualitative approach combined with methods of descriptive statistics was seen appropriate as the networks and especially the network opportunities had first to be explored. But also for understanding network dynamics and interpreting the links between the actors in hindsight of adaptive capacity to climate variability and change, qualitative methods were favored. No literature could be found about analyzing network opportunities. For the study at hand, not only the *existing* social networks of individuals were regarded important for influencing their adaptive capacities but also the *possible networks opportunities* the actors have at hand. The combination of actually existing social networks and possibilities for further networking was called *social opportunity network* in the analysis.

3 Research Methodology

3.1 Research site

3.1.1 Site selection

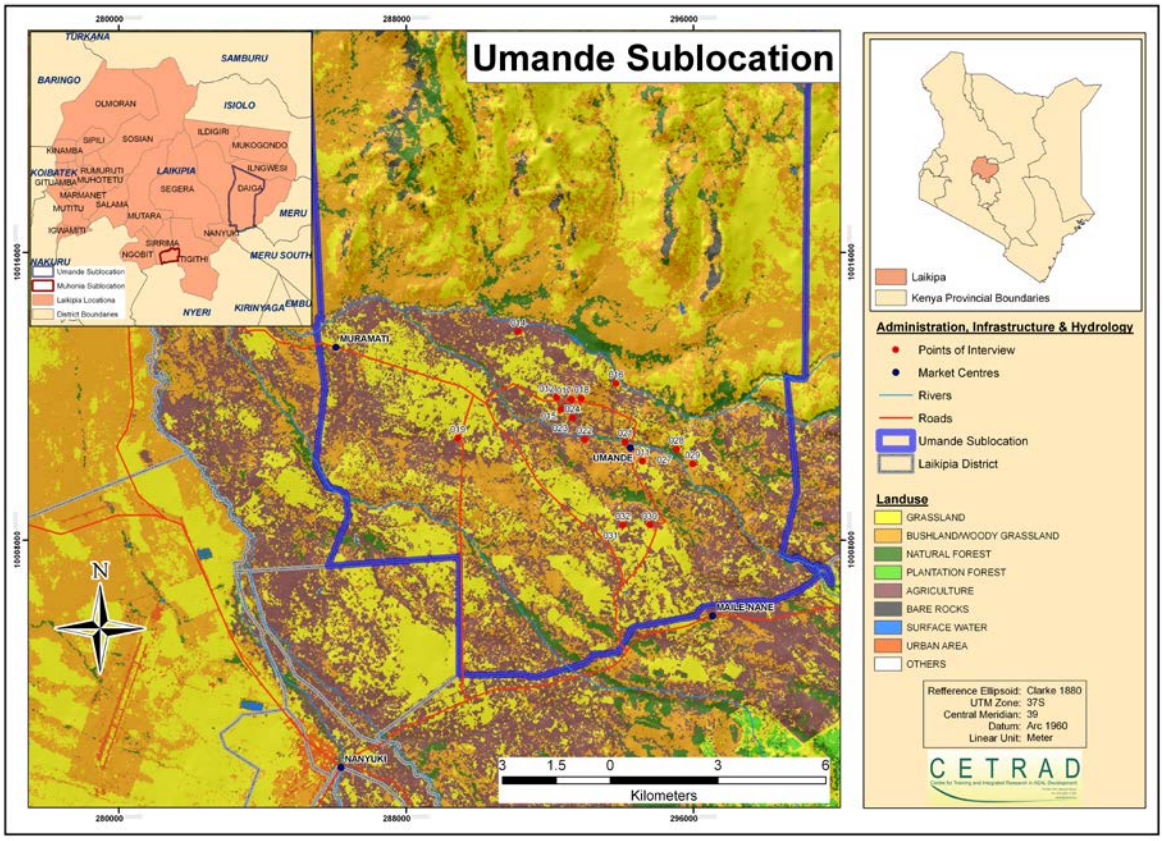
The site chosen for this study is Umande sub-location in Muramati location, Laikipia East District of Rift Valley Province, Kenya. Umande sub-location is one of two research sites of the PhD project "Assessment of local agronomic practices in small-scale agriculture as building blocks for adaptation to climate change in Laikipia District, Kenya" by M.Sc. Sarah Ogalleh Ayeri, within which this study was designed and conducted. Umande sub-location was preferred over the other study site (Muhonia sub-location in Lamuria location) for the research project at hand. The main reason for this decision was that Umande sub-location has been researched quite well and therefore provides a comparatively better literature basis especially on geographical and agricultural issues. At the same time this assumed advantage was also seen critically as a possibly "over-researched" community has the potential of jeopardizing the results (see "3.7 Ethical considerations"). During data collection this apprehension could not be verified. Another reason for choosing Umande sub-location was its comparatively easy accessibility; carrying out the same research project at the other research site of Ogalleh Ayeri's PhD project would have exceeded the time frame and the research budget of the study at hand by far.

3.1.2 Site description

Bio-geographic conditions

The study area is located on the north-western slopes of Mount Kenya (5,199m asl) on the semi-arid Laikipia plateau. Situated at an elevation of 1,600m asl – 2,200m asl this high plateau is characterized by rolling hills which are sloping steeply toward the lowlands of the arid Samburu plains in the north. To the south-west the Laikipia plateau is hemmed by the Abedare mountain range and to the east and south the plateau ends in the highlands of Mount Kenya (Flury 1988: 265). The following figure shows the geographic location and the typical land use patterns of the study site:

Figure 2: Geographic location of the research site



Source: Center for Training and Integrated Research in Arid and Semi Arid Lands Development (CETRAD), 2011

These geographic features contribute to the local distribution of rainfall.

> Mean annual rainfall declines along a steep gradient, from 800-900 mm at the foot of both massifs, to under 500 mm in the northern part of the District. Rainfall is characterised by great variability in terms of amounts and time and increase along the same gradient. Agro-climatic zones vary according to precipitation gradients, from semi-humid (Zones III and IV) to semi-arid (Zones V and VI).Great variability in precipitation means, however, that there is great spatial and temporal fluctuation in the critical boundary for rainfed agriculture between Zones IV and V on the high plateau. (Wiesmann 1998: 14)

The seasonal distribution of rainfall is a result of the influences of the Inter-Tropical Convergence Zone (ITC) and of northeast and south trade winds. Normally, the area has a bi-modal rain pattern and experiences two rainy seasons a year with long rains occurring from around March to May and short rains from October to November. According to Notter et al. (2007) however, the rainy seasons vary from year to year in duration and rainfall totals (Notter et al. 2007: 267). Furthermore, a "heterogeneous spatial distribution of rainfall" has been observed in the area "which is common in the tropics due to a mainly convective atmospheric circulation

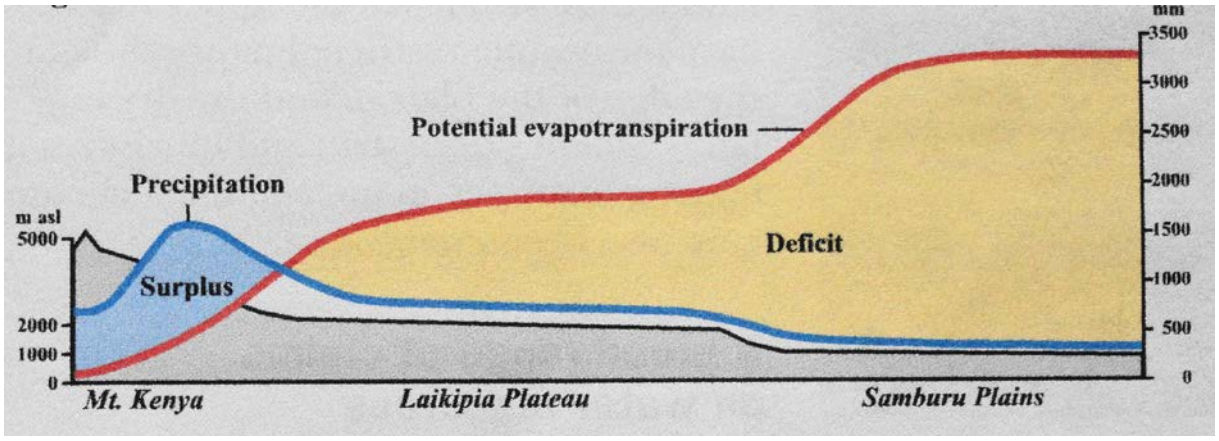
pattern – a small area can experience heavy rain while at a distance of only one kilometer no rainfall occurs at all" (Notter et al. 2007: 273).

The rainfall patterns and climatic conditions of the Laikipia plateau are further influenced by its vicinity to Mount Kenya: The elevation gradient determines the rainfall patterns of the area greatly and constitutes various climatic zones, ranging from humid to arid (Ngigi/ Savenije/ Gichuki 2007: 130). Being an equatorial volcano Mount Kenya has a very unique ecosystem with diverse ecological and climatic zones. From the mountain peak to the Laikipia plateau five ecological zones have been described: "The afro-alpine zone (above 4,000m a.s.l.), the wet moorland zone (3,200 – 4,000m), the tropical rainforest zone (2,300 – 3,200m), the semi-humid foot zone (2,000 – 2,300m) and the semi-arid savannah zone (below 2,000m)" (Gichuki et al. 1998, cited from Notter et al. 2007: 267). Adjacent to the semi-arid savannah zone where the Laikipia high plateau is situated there are the arid Samburu plains. Both lowland forms are highly dependent on water coming from Mount Kenya:

> The mountain, and in particular its rain forest belt, guarantees dry season river flow due to high rainfall, low evapotranspiration and high water retention capacity. As potential evapotranspiration exceeds precipitation with distance from the mountain, the perennial character of the river becomes most important in the lower zones. Mount Kenya is therefore the water tower for the footzone and the adjoining lowland areas. (Wiesmann et al. 2000: 11)

The following figure shows how the mean annual precipitation declines with increasing distance from the "water tower" Mount Kenya:

Figure 3: Annual water balance on Laikipa plateau



Source: Wiesmann/ Liniger (1999) adapted from Wiesmann et al. 2000: 11

It can be summarized that due to its geographic position the temporal and spatial variability of rainfall is generally high on the semi-arid Laikipia plateau.

The natural land cover of the Laikipia plateau is typically grassland with 20 - 50% tree canopy (transition zone between Mount Kenya forest and the savannah) (Notter et al. 2007: 267). Since most of the land is under cultivation nowadays, there is not much original vegetation left and large parts of the original forests have been cut down.

Socio-economic conditions

In pre-colonial times the area was sparsely populated, the extensive plains of the Laikipia plateau with its vast Savannah vegetation were mainly used by traditional pastoralists (mainly the Massai and the closely related Samburu) as grazing grounds for their herds (Flury 1988: 266, Wiesmann et al. 2000: 11). The arrival of European colonists in the early 20th century marked the beginning of a rapid socio-economic development of the area, in which the pastoralists were displaced to the lowly productive and drought-prone edge of the Laikipia plateau and to the dry Samburu plains. The official policy of the East Africa Protectorate (which was transformed into a British Crown Colony in 1920) was to reserve certain agricultural lands in Kenya for settlers of European origin (Morgan 1962: 140). By this administrative practice, the regions' name as "White Highlands" was put on the map. During 60 years of colonial settlement the grazing lands of the pastoralists were occupied and transformed into large-scale farms and ranches owned by Europeans.

> The reservation of the Highlands for Europeans by administrative practice was ended by the Land Control Regulations made in 1961 […] and the provision that a non-European might not manage or control land granted to a European in the Highlands was removed from the Crown Land Ordinance by the Crown Lands (Amendment) Ordinance, 1960. (Morgan 1962: 143)

After independence in 1963 and throughout the 1970s and 1980s, many of the ranches and farms owned by white settlers were sold and subdivided into small plots for African agro-pastoralists who emigrated from neighboring overpopulated areas. Due to high population pressure these smallholders had left their homes of high agricultural potential located to the south and east of Mount Kenya and settled on the Laikipia plateau (Wiesmann et al. 2000: 11, Kiteme/ Gikonyo 2002: 333). In the course of their immigration they introduced new farming systems and land use practices to the region. But since the crops and cultivation methods originated from high-potential areas they were often not suitable for farming on the Laikipia plateau as they were not adapted to the special geographical (esp. climatic) conditions of the region (Aeschbacher et al.

2005: 155, Kiteme/ Gikonyo 2002: 333). With the new African immigration and settlement also regional towns and trading centers were established. Throughout the 1990s most of the remaining large-scale farms in the foot zone of Mount Kenya "were transformed into highly technical horticultural enterprises oriented toward international markets" (Wiesmann et al. 2000: 11). The land use practices have greatly changed over the past century as has the land tenure. According to Kiteme/ Gikonyo (2002) this has led to

> a dramatic transformation in social composition, from a simple pastoral society to a complex multistakeholder society ranging from the footzones down to the Laikipia Plateau and the Samburu Plains. This society consists of an urban population in the regional towns and trading centers, large-scale horticultural irrigators, small-scale horticultural outgrowers (ie, small-scale farmers contracted by large-scale farmers to produce exclusively for them), agropastoral smallholders, large-scale ranchers, pastoralists, and international tourists. (Kiteme/ Gikonyo 2002: 333)

With the transformation of land use, a rapid growth of population has concurrently set in (a ten-fold increase from 1960 to 2000, Wiesmann et al. 2000: 12). The intensification of irrigated agriculture and the population increase on the plateau have dramatically raised water demand in the past decades (Liniger et al. 2005: 163, Wiesmann et al. 2000: 12). Additionally, new forms of land use increase the pressure on water supply:

> Aside from the fresh water requirements of urban centers and tourist resorts, increased agricultural production plays the most significant role. First, agro-pastoralist smallholders increase small-scale irrigation in order to be able to counterbalance the high risks caused by the great variability in rainfall; although justified by the severe problems of survival they face as the largest group of inhabitants in the Basin, their claims are virtually unlimited. Second, water requirements for year-round export-oriented horticultural production are high, even though advanced technologies such as drip irrigation are used. (Wiesmann et al. 2000: 12)

The demand is naturally highest during dry spells in the rainy seasons and during the dry seasons. While abstractions from the rivers through various supply systems are ever increasing, the annual rainfalls are not. This has lead to a decrease in river water flow by about 30% since 1960 and it has increased water scarcity following the rivers to the lower reaches (Ngigi/ Savenije/ Gichuki 2007: 131). Even though there is excess water during rainy seasons, the storage facilities for water coming from the mountain are still insufficient and they do mostly not have the potential to bridge the following drought during dry seasons. As a result, the perennial rivers and tributaries fall dry with increasing frequency. The increase of water scarcity and the total lack of water, especially in the lower reaches of the rivers, have lead to conflicts between upstream and downstream water users (Ngigi/ Savenije/ Gichuki 2007: 131, Kiteme/ Gikonyo 2002: 334ff., Wiesmann et al. 2000: 12).

3.2 Research and interview partners

3.2.1 The research partners

For various reasons this research centers on small-scale farmers. First of all, small-scale farmers are directly dependent on their surrounding environment and they have active experience with changes in it as well as with adaptation to those changes. Secondly, despite being used to adapt to an ever changing environment, small-scale farmers are now facing new challenges arising with climate variability and change which pose a serious threat to sustaining their livelihoods.

The research partners for the study at hand were 28 small-scale agro-pastoralists from Umande sub-location who were interviewed during 6 focus group discussions (4 – 5 per group discussion).

Additionally, 7 experts from organizations working with the small-scale agro-pastoralists were interviewed in 7 in-depth interviews to gain a fuller understanding of the agro-pastoralists' life realities.

Small-scale agro-pastoralists

The small-scale agro-pastoralists constitute the majority of inhabitants in the area (Wiesmann 2000: 12). Their farms are run on a household basis with the women typically dealing with the main bulk of agricultural work. Small-scale agro-pastoralists practice a combination of crop cultivation and livestock production. The typical size of their plots is quite small (< 4 ha), usually they produce food crops for subsistence and sell surplus if they have any. Some smallholders also produce cash crops for local markets and/ or have contracts with local large-scale agricultural enterprises as out-growers. Most of the small-scale agro-pastoralists rely totally on rain-fed agriculture. Among the main crops grown are maize, beans, potatoes, pumpkins, wheat, peas, cabbage, kales and spinach. Livestock found on their farms includes cattle, poultry, goats and sometimes sheep. The smallholders keep small numbers of cattle (usually 1 - 3 cattle) for subsistence in terms of milk. Small ruminants are mainly kept to provide supplementary cash income for school fees and other household expenses. In times of total crop failure the selling of livestock can be seen as a strategy to maintain their livelihood securities, even though during droughts the prices for livestock usually drop drastically. Moreover farmers keep poultry for subsistence egg and meat production as well as to be sold at local markets. Coming from resource rich and high-potential agricultural areas the immigrated farmers have been struggling a

long time with the natural conditions found on the Laikipia plateau. Up to today the types of crops they are cultivating often need plenty of water for irrigation like the mainly grown maize varieties, among others. Likewise, collecting and storing rainwater for irrigation and domestic use have not been widely-used practices in the area.

Experts

After the group discussions with the small-scale agro-pastoralists were concluded seven in-depth interviews with experts working with the smallholders were carried out. These experts were: The provincial director of agriculture of NAFIS (National Farmers Information Service), Nairobi, Kenya; an official of the Ministry of Livestock Development, Nairobi, Kenya; an official working for Syngenta Foundation, Nanyuki, Kenya; an official working for World Vision, Nanyuki, Kenya; an official working for the Water Resource Management Authority (WRMA), Nanyuki, Kenya; an agricultural extension officer working in Umande sub-location, Kenya; an official of a Water Resource Users Association (WRUA) in Umande sub-location, Kenya.

Of these, five experts were purposefully selected for the in-depth interviews after they had been identified as network actors by the small-scale farmers during the Net-Map group discussions. Two experts were purposefully contacted as they were well known for their competence in agricultural matters.

The information gathered during these interviews was seen as *additional* information to better understand the social realities of the smallholders; however the main data basis was derived during the group discussions with the smallholders.

3.2.2 Sampling

The study population for the study at hand was identified as the total of all accessible small-scale agro-pastoralists of Umande sub-location in Laikipia District, Kenya. The study was designed with qualitative research methods and it was planned to analyze the expected data from the interviews also with qualitative methods. Therefore a sample size of 24 (minimum) – 30 (maximum) individuals was thought to be reasonable for the purpose of this study. The sampling of the study was then done in three steps: 1. Purposive sampling, 2. Grouping, 3. Random sampling.

Step 1: Purposive sampling:

Since this research project was carried out as an in-depth study of M.Sc. Sarah Ogalleh Ayeri's doctoral thesis, the sample of her study site in Umande, Laikipia District, was purposively used as the sample frame for the study at hand. The actual sample frame therefore was pre-sampled; it consisted of 100 small-scale agro-pastoralists who had already been interviewed by M.Sc. Sarah Ogalleh Ayeri during her field work. (The original sample frame consisted of 106 small-scale farmers but since by the time this study was undertaken not all participants' data were available, the existing total of 100 small-scale farmers was taken for the present study.)

The sampling criteria for those 100 small-scale agro-pastoralists had been:

A) The size of the according small-scale farmers' properties must not exceed 10 acres of land.

This criterion was intended to ensure that the sampled farmers did actually practice agriculture on a small scale.

B) The small-scale farmers must have lived in the area for at least 20 years.

This criterion was intended to ensure that the small-scale farmers could actually provide information regarding climatic changes and trends in the area.

C) The small-scale farmers must use mixed agricultural practices which is a combination of crop farming and animal husbandry.

This criterion was intended to ensure that the small-scale farmers were actually agro-pastoralists and could thus provide comprehensive information on perceived changes in agriculture.

The sample frame being the sample of Ayeri Ogalleh's sample, it was available in form of a list of 100 small-scale agro-pastoralists in Microsoft Excel.

Step 2: Grouping

In order to find out whether the small-scale farmers' social networks influence their ability to cope with climate variability and change the farmers were grouped according to their abilities to cope with the 2009 drought that hit the area. Therefore the possible 100 interviewees were grouped according to the answers they gave in the M.Sc. Sarah Ogalleh Ayeri's interviews about their perceptions of their own vulnerability to climate-induced shocks. The following two questions of Ogalleh Ayeri's interviews addressed the farmers' perceptions of how successful they considered themselves compared to the other farmers in the 2009 drought that hit the area:

Question 1: Where do you place yourself in terms of crops production during the drought in 2009? a) better-off; b) moderate; c) worse-off.

Question 2: Where do you place yourself in terms of livestock production during the drought in 2009? a) better-off; b) moderate; c) worse-off.

The answers given to both questions were combined using SPSS and 3 groups were formed:

Group “better-off” (41 individuals): These were the farmers who rated themselves as better off in comparison to other farmers in the area.

Group “moderately” (37 individuals): These were the farmers who rated themselves as moderate in comparison to other farmers in the area.

Group “worse-off” (22 individuals): These were the farmers who rated themselves as worse off in comparison to other farmers in the area.

Step 3: Random sampling

From these 3 groups a total of 30 smallholders were randomly sampled. Since the groups were of different sizes, every 4th person was selected from group “better-off”, every 3rd person was selected from group “moderate” and every 2nd person was randomly selected from group “worse-off”. The random sampling was done in order to avoid bias and in order to a gain broader structural variation that qualitatively resembled the total of the sampling frame. For reasons of feasibility the 3 groups were finally divided into 6 groups so as to ensure that group discussions with 4 - 5 individuals could be held. Two of the invited farmers could not attend the group discussions, so that eventually the total of smallholders interviewed consisted of 28 farmers. The following list gives an overview of the small-scale farmers who eventually participated in the group discussion:

Table 1: List of farmers participating in group discussions

Groups	Number of farmers participating
Group better-off 1 (bo 1)	5 Farmers
Group better-off 2 (bo 2)	4 Farmers
Group moderate 1 (mo 1)	5 Farmers
Group moderate 2 (mo 2)	5 Farmers
Group worse-off 1 (wo 1)	5 Farmers
Group worse-off 2 (wo 2)	4 Farmers
Total	28 Farmers

Source: Table compiled by author

3.3 Data collection

3.3.1 Interview groups

With the help of a local resource person, the 30 sampled small-scale agro-pastoralists were invited either personally or by telephone to group discussions. Surveying the smallholders' social opportunity networks in groups was thought to bring more valuable and rich data than doing it in individual interviews. The underlying assumptions were that the farmers could probably think of more actors and more links of their opportunity networks when they could think "together". Aside from using this collective capacity, it was further assumed that a group discussion held more potential of creating a comfortable interview situation where the smallholders would open up and talk freely. Another advantage of holding the interviews in groups was saving time and expenses. Given that a Net-Map discussion takes about 2 - 3 hours, 30 individual interviews with the Net-Map method would have gone beyond the scope of this study. It was further thought sensible that the group size should not be smaller than 3 people and that it should not exceed 6 people, especially since the discussions were held in Kiswahili with translations to English or from the local language of Kikuyu to English. The interviews were finally conducted in 6 groups with 4 - 5 people in every group.

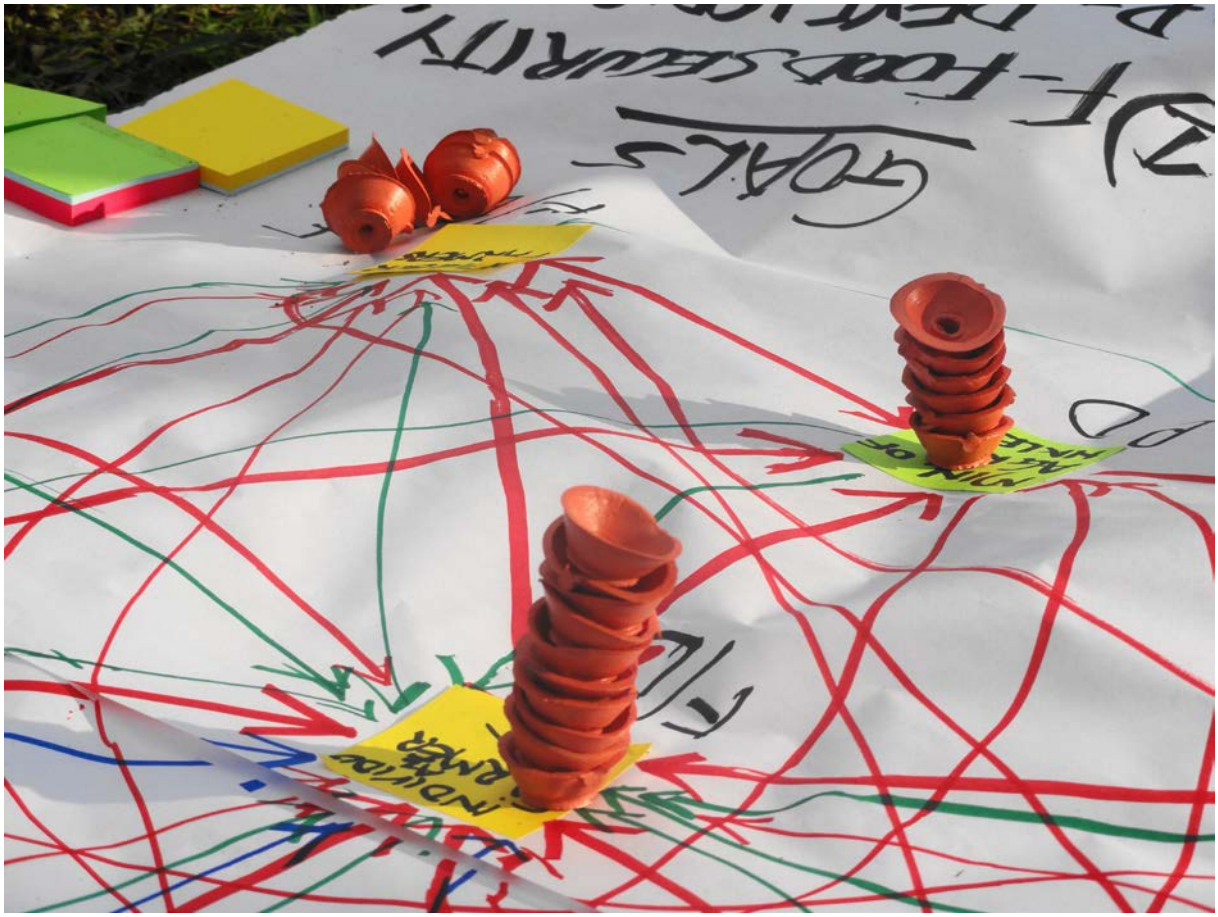
3.3.2 “Influence network mapping” (Net-Map)

The Influence Network Mapping (Net-Map) is a fairly new and innovative mapping tool for social networks. Most approaches for collecting and analyzing social network data are very abstract and require special computer programs and high technical capacity (Schiffer 2007: 2). Contrarily, the Net-Map toolbox is a low-tech and low-cost alternative which allows collecting data about social networks in the field and mapping social networks on the grassroots’-level. Beside its advantages for conducting field research it predicates its strengths on a distinct participatory approach and on its ability to make social networks visible and comprehensible to anyone regardless their level of literacy or education. The tool “[…] helps people understand, visualize, plan, discuss, monitor, evaluate and improve situations in which multiple actors influence the outcomes of any development intervention. Net-Map integrates the basic principles of social network analysis, stakeholder analysis, action research and power games” (Abukari/ Schiffer/ Hauck 2009: 2). Furthermore, the

> tool can produce both qualitative and quantitative data to increase network understanding by going beyond the purely structure-driven approach of social network analysis (SNA) and combine structural measures with measures of attributes of actors, especially concerning their perceived influence and their goals. (Schiffer/ Hauck 2010: 232)

For those reasons the Net-Map tool was chosen as the apt methodological approach to the research question. The tool is applied in different steps aiming at the identification of actors, of network linkages and the relative influence that the actors have in the network. Small figurines or labeled post-its represent different actors, lines are drawn between the actors representing the links between them and influence towers are built which reflect the relative influence the actors have. The following figure provides an example of a Net-Map situation showing the actor “Individual Farmers” with its links and its influence. The influence tower here consists of rubber gaskets.

Figure 4: Net-Map actor with links and influence towers



Source: Photo by author

3.3.3 Preparation and pre-testing

When applying the Net-Map tool for collecting network data, an overarching question had to be pre-defined for all Net-Map discussions. This question was the main topic of the 6 group discussions and everything discussed during the interview processes was discussed before that background:

"Who influenced/ influences your decision and adoption of agricultural practices in years of extreme weather conditions like 2009 and 2011?"

Also, possible links of the actors related to that question were pre-defined as part of the Net-Map preparation. Three links were thought to be sufficient as more links might have only complicated the process without bringing new results. These links were:

1. "Information and/or advice" (i.e. agricultural knowledge, news about innovations or where to get resources etc.),

2. “Resources” (i.e. flows of funding, seeds, animals, technical support, etc),

3. “Enforcement” (i.e. formal lines of command, pressure, rules and regulations, restrictions, etc.).

The Net-Map data collection tool was pre-tested twice. First, a pre-testing was done with research colleagues. This yielded interesting results about the researchers’ assumptions concerning the small-scale farmers’ social opportunity networks. Second, a random pre-testing was done with small-scale agro-pastoralists who were not part of the sampling of this study. This session yielded first interesting insights into the actual social opportunity network situation of the smallholders and the differences to the researchers’ assumptions about them. Because of their explanatory power, some of the results gathered in this group meeting were also used as additional information for the discussion of the results.

3.3.4 Net-Map group discussion

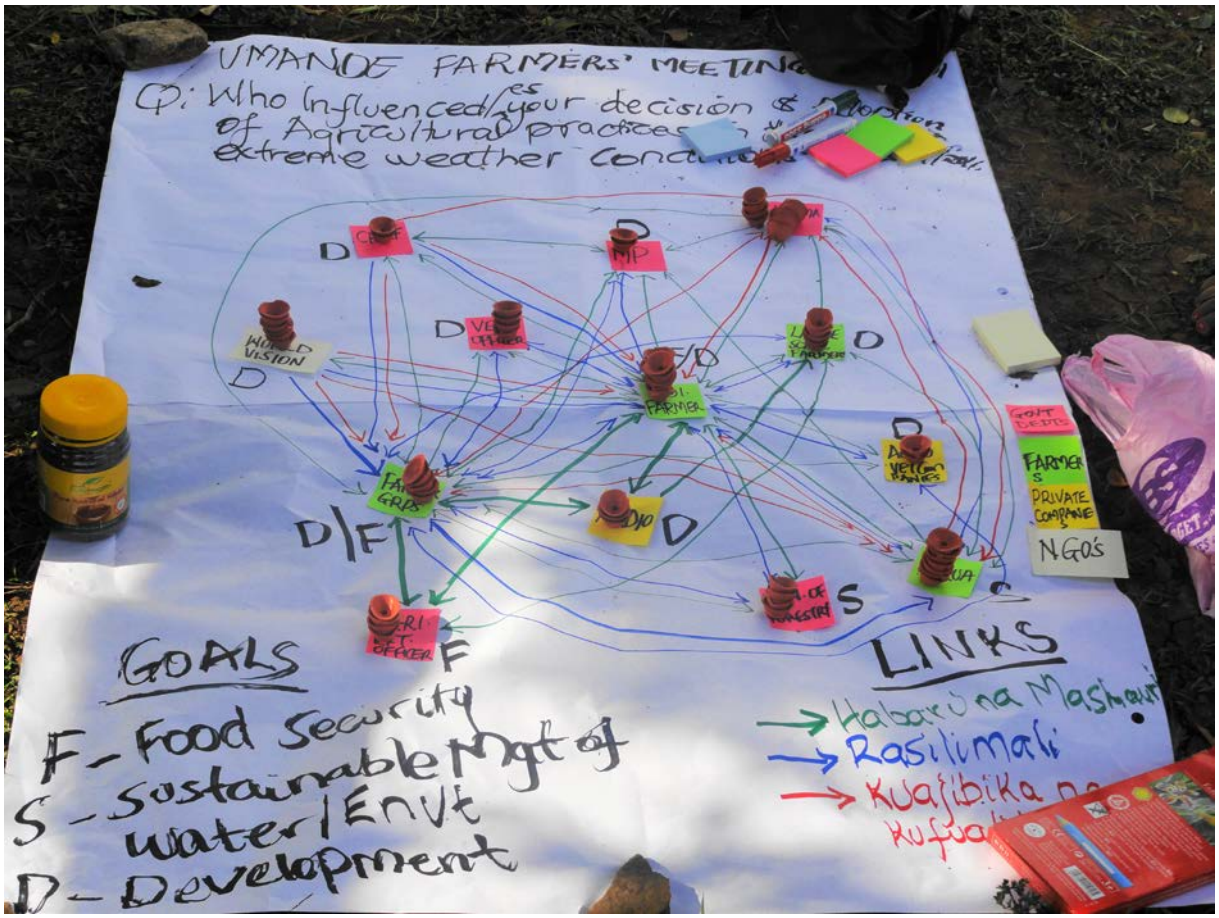
The data collection was accomplished between July 25th, 2011 and August 8th, 2011. It was done in six group discussions with 4 - 5 participants per session. The usual procedure in every interview was:

The interview started with an opening address and a short introduction of all people present. It was then explained what the intentions and goals of this research were and how the data were going to be used. In a next step, the Net-Map tool was shortly explained and questions relating to it and/ or to the process were answered. The working materials were then spread out and the overarching the Net-Map question was introduced (“Who influenced/influences your decision and adoption of agricultural practices in years of extreme weather conditions like 2009 and 2011?”). The small-scale farmers were invited to explain how they understood the question and a common understanding was sought. The question was then written on the flip chart and it was tried to identify all actors of the farmers’ social opportunity network. As a name generator the question “Who is involved?” was put to the farmers. They were encouraged to name all individuals, groups and organizations that - in their opinion - influenced their decision and adoption of agricultural practices during years of extreme weather conditions. Actors not yet identified could be added throughout the interview. Usually, the small-scale agro-pastoralists already gave a lot of explanations concerning their relations with the identified actors at this stage. The identified actors were then grouped into actor groups, written on actor cards (post-its) and distributed on the map (flip-chart). In a next step it was examined how the farmers were

connected with the identified actors, respectively which links the actors (information/ advice, resources, enforcement) they shared with each other. Every link was drawn with differently colored markers between the according actors on the flip-charts. Finally, the amount of influence an actor has on the farmers' agricultural decisions and adoptions was established. Therefore, the farmers were given rubber gaskets with which they were invited to build influence towers. 1 rubber gasket resembled 1 point of influence, it was generally agreed on scales ranging from 1 - 10 (respectively 1 - 5 in one group discussion). The higher the farmers perceived the actor's respective influence on their decision or adoption of agricultural practices, the higher the tower was piled up. Actors could have towers of the same height and if they were perceived as not influential at all, no gasket was applied. During this process the interviewees gave a lot of explanations about why and how they perceived an actors' influence as they said and discussed about it. The numbers of gaskets was finally noted on the flip chart next to the according actor. A last question was put out concerning the goals of the actors. Typically these goals were livelihood security, development, environmental conservation and business. These data (goals) collected were not further analyzed during the study. Rather, with the identification of the goals it was intended to gain a broader picture of the whole social opportunity network situation. Once the map was completed, the overall picture and some results of the process were discussed again before the session was terminated. Since in one Net-Map group discussion some of the participants were illiterate, previously prepared figurines were used that resembled the actors. The following figure shows the typical (visual) outcome of a Net-Map group discussion.

Figure 5: Example of a Net-Map flip-chart

showing the overarching question, the identified actors on post-its (color of post-its representing actor group), the links (green: information/ advice, blue: resources, red: enforcement) the influence towers and the goals of the actors



Source: Photo by author

3.3.5 Semi-structured expert interviews

For the semi-structured interviews with five experts from different actor groups of the farmers' social opportunity networks one guideline was designed. With minor adaptations according to the different working fields of the actors the same guideline was used for all five interviews. The mean duration of one interview was 45 minutes to 1 hour. The aim of these in-depth interviews was twofold: First, getting a better overview over the complex picture of the network structures. Second, getting additional information or explanations for phenomena which had not been explained by the farmers. The interview guideline for the semi-structured interviews can be found in the annex.

Two more in-depth interviews were carried out via telephone. Unlike the systematized interviews with a distinct guideline, those two interviews were explorative, meaning that only very basic guidelines were used for acquiring additional information and facts.

3.4 Data storage

The data collected during the six Net-Map discussions was recorded and stored with different techniques using different (technical) devices. The group discussions were recorded with a voice recorder and after every group meeting copied onto a lap top. These recordings held the explanations to the Net-Map pictures which had been the outcome of every group discussion. The Net-Map flip-charts were another form of saving data; they contained all the structural data about the social opportunity networks of the farmers. In order to be able to reproduce the Net-Map flip-charts anytime and to store them, pictures were taken of them using a standard camera. These pictures were also copied onto the previously mentioned lap top. All data were additionally copied onto a flash disc. Finally, also data was collected using methods of participate observation. These data were written down by hand using a research diary. The expert interviews were also recorded with a voice recorder and copied to the lap top.

3.5 Data analysis

3.5.1 Data preparation

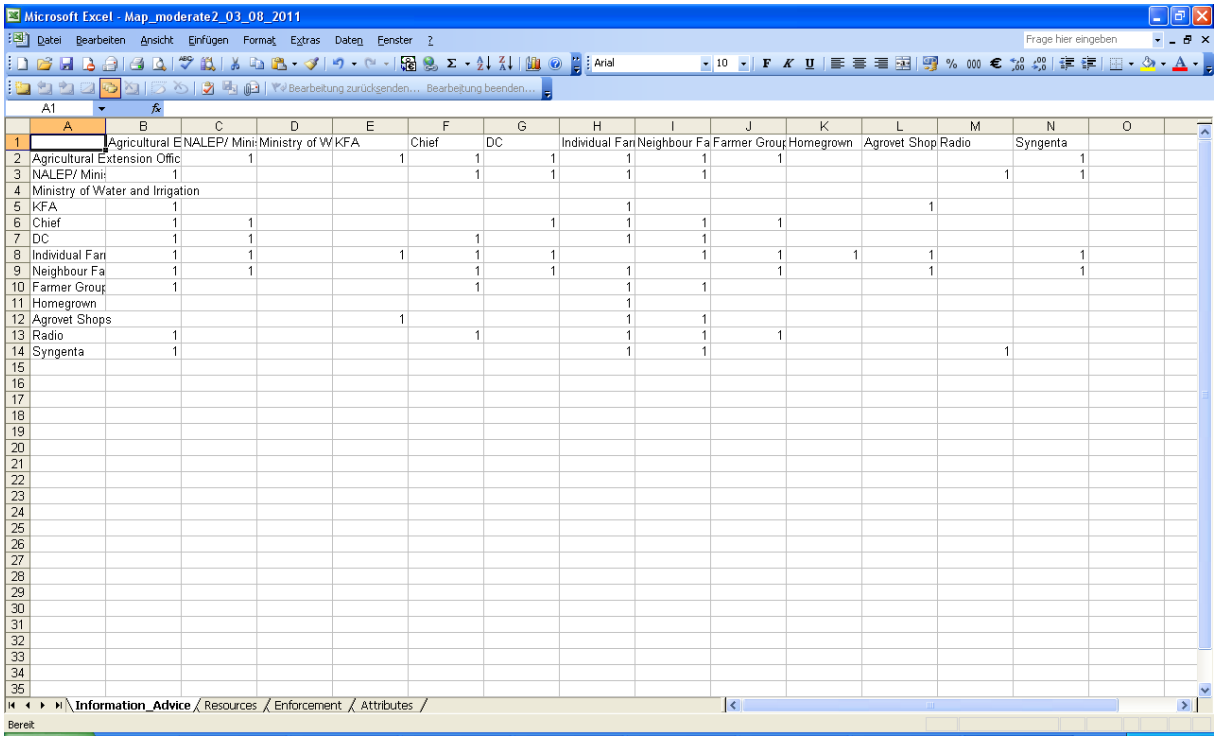
Preparation of the recorded interviews

First of all, the recordings of the six Net-Map group discussions were transformed from audio files into a written form in order to be able to further analyze them. Additionally, since the group discussions had all been held in Kiswahili, respectively in Kikuyu, they were translated into English first. The audio files had a total duration of 12 hours and 49 minutes and were transcribed using the transcription program “F4”. The translation was accomplished with the help of a Kenyan research assistant fluent in English, Kiswahili and Kikuyu. After translating, transcribing and entering the data into a computer various database structures were developed.

Preparation of the Net-Map flip-charts

Every Net-Map discussion was analyzed separately at the beginning to collect every actor of the networks, every link of the networks and the respective number of points the farmers had allocated to every actors' influence on their own agricultural decisions ("influence points"). Therefore, all identified actors of one Net-Map discussion were listed in a downward directed column on a Microsoft Excel sheet. The column was copied and pasted on top of the Excel sheet in a horizontal row. Thus a matrix was established. On this first Excel sheet it was noted whether the actors exchanged "information and advice" among each other. If there was an exchange a "1" was put, if there was no exchange nothing was put. This method also shows the direction of the link. Then, the same was done for the links "resources" and "enforcement" but on different sheets in the same file. In a fourth sheet (attributes) of the Excel file the absolute number of "influence points" was noted in a vertical column without creating a matrix. In a second row the relative number of "influence points" was put, the relative number being the absolute number divided by the maximum possible number of "influence points". For every group discussion one file with 4 sheets was created. The following figure presents an example of data entry for further analysis:

Figure 6: Example of data entry using MS Excel



Source: Screenshot by author

Visualization of the data

These files were uploaded into a program called “VisuaLyzer 2.0” which is designed to make social networks visible by generating a visualization of it. The program generated 6 visualizations of the 6 group discussions. With this visualization program it is also possible to further analyze the data quantitatively (traditional SNA methods) if a quantitative data analysis is favored. In this case the data was analyzed qualitatively therefore the visualizations were only used for data preparation and to get an overview over the six surveyed networks.

3.5.2 Data analysis

The data gained in the 6 Net-Map group discussions as well as the data gained in the in-depths interviews were analyzed with different methods of social research.

Since no established approach for the data analysis could be found, a new method of qualitatively analyzing social networks combining structural elements had to be developed specifically for the study at hand. In the following paragraphs this analytic method will be described.

Collecting and weighing actor information

The analytic process began with an actor-based analysis. First, every identified actor of every group discussion was listed in a chart. Thereon all relevant information found in all six transcripts of the Net-Map discussions about the flow of “information/ advice” was collected in a column next to it. In two more columns the same was done with the flow of “resources” and the exertion of “enforcement”. Relevant information included the sort of “information/ advice”, the sort of “resources” and the sort of “enforcement”, their amount (visible in the enumeration) and the according explanations why they are interchanged. In a third column the farmers’ statements about the influence which every actor had on their agricultural decision was collected as well as the reasons they gave for it. For a better understanding the following table provides a condensed excerpt as an example of how these collections looked liked. The original tables provide information from all six group discussions about only one actor at a time.

Table 2: Condensed example of collecting actor information

Who	Kind of information	Kind of resources	Kind of enforcement	Influence on farmers' decision
Agricultural extension officer (bo2)	- Fodder conservation practices for livestock (silage, storage, p.8) - Prevention of soil erosion (p.24) - Breeding the "right grade" of livestock (p.8)	- Wheel barrows, spades, aprons during shows (p.19)		Person 3: Give them 2, because they just teach us on soil erosion prevention in the farm. (p. 24)
Individual farmers (bo1)	- Know-how on preparing the land and cultivation, plowing, planting, weeding, timing of planting ("we are able to tell when the rains are just about", p. 13/ "we know the month when we are supposed to prepare the land" p.14) - Prices of seeds: short-term crops more expensive, long-term crop seed cheaper. - Changing rainfall patterns (p.15)			- Learning by doing: "In my view one of the problems we face, though we are also assisted by external actors, is a situation whereby we teach ourselves out of the problems we go through." (p. 13) - Cultivating both short-term and long-term crops, in case one fails due to lack of rains (p.14/ 15) - Choose the type of seeds according to their financial ability (p.14) - Plant drought resistant seeds (p.15)

Who	Kind of information	Kind of resources	Kind of enforcement	Influence on farmers' decision
WRUA (mo1)	- Use of river water/ water rationing/ regulation (p.16) "The WRUA sets certain regulations with regard to water use, for example, they may set the time between 6 pm and 6 am as the only time one is supposed to use river water for irrigation. We may respond by informing them, that this is not efficient, because a lot of water is wasted due to darkness." (Person 3, Transcript mo2, p. 16)	- Tree seedling for WRUA members to be planted along the riparian (p.19) - Farmers "pay for water" (p.19) "With regard to the ministry of water, they are usually represented in the location by the WRUA. WRUA provides us with resources, such as tree seedlings to people whose farms touch the river bed to plant along the riparian. For one to be a member of WRUA there is a membership fee." (Person 1, Transcript mo2, p.19)	- Follow-up on irrigation practices, take away pumps in case of malpractice and hand them over to ministry officials (p.19) "The WRUA, they usually follow up on irrigation practices of farmers, for instance, on being informed by the ministry officials of some people who are irrigating during the day, they will come and take away the farmers' pumps and hand them over to the ministry officials. It is two ways in that since we pay for water, in case there is no water in the rivers we follow up with the WRUA people." (Person 1, Transcript mo2, p.19)	Person 3: I give the WRUA 8, because without them we may not be able to conduct irrigation well, they regulate water. (p.22) Person 1: According to me, WRUA is more visible than the ministry in this location. (p.26)

Source: Table compiled by author

Combining these tables of relevant actor information with the 6 visualizations of the smallholders' social opportunity networks, a clear structure became apparent. The detailed step-by-step analysis of the surveyed social opportunity networks of the six groups of farmers produced what is called in the following a "core" network structure.

The core social opportunity network

Please imagine the following metaphoric situation: You are the researcher trying to understand the social opportunity networks of the smallholders. Therefore you are holding six sheets of paper in your hands which all have been painted with black watercolors. They are black, but if you hold them against a source of light, you can still see some amount of light shining through. These sheets represent the surrounding of the six social opportunity networks of the small-scale farmers.

Now you are taking different sized knitting and sewing needles and you are making different sized pinholes into the sheets. The pinholes represent the actors; the size of the pinhole represents the influence an actor has. The pinholes have their specific locations on the sheets depending on their relations to the other actors. If they are recurring on different sheets, they will have the same location on every sheet so that they can be found easily again.

With a fine needle you are now drawing links between the actors. The more links between two actors exist (meaning: the more different kinds of things like information and resources are being interchanged), the broader and better visible the path becomes.

If you put these six sheets of paper on top of each other and hold them against a strong source of light, you will see a core network emerging. The overall picture will look like stars or constellations on the firmament: Some actors will shine brightly and like in a constellation they will be in some relation to the other actors. And some actors will hardly be visible, stand in no connection with the others or they will be far away in the periphery, like satellites or far away stars and galaxies. The light will shine directly through six pinholes if they are lying upon another – this actor (that has been mentioned six times) will appear very intensely in the overall picture. Also, the bigger the pinholes are the better the light will be shimmering through. This actor (that has a bigger amount of influence) will also be seen quite clearly against the black background. Others which are smaller or only pinned into one or two sheets will hardly be seen. They will take far away positions in the sheets, and they will seem to come and go. The same applies for the links which you have carved into the sheets. Some are like deeply caved paths that are clearly visible and obvious, others are like hidden paths or hardly used by anyone. But a tiny satellite or a far away galaxy might be just as important for the whole structure as a clearly visible star and a hidden path might be a better option in the network than using the beaten track. There might be unknown and undiscovered possibilities and resources.

With this metaphor in mind the core network of the six collected opportunity networks was found. The core network consisted of several main or core actors, actors which had been mentioned often by the farmers or whose influence on the farmers' agricultural decisions had been ranked high by themselves – the bright and big stars or constellations. Beside the core network there were also the distant galaxies, the small stars and the satellites: Actors that could be found in only a few or maybe even in only one network, or whose influence on the farmers' agricultural decisions had been ranked low by the farmers, but they still *might* have been of great importance for the core network. The reasons for their importance in the core network will be explained in the ongoing analytic process, main reasons were for example the content of the interchanged links or the structural position of an actor in the core network, among others.

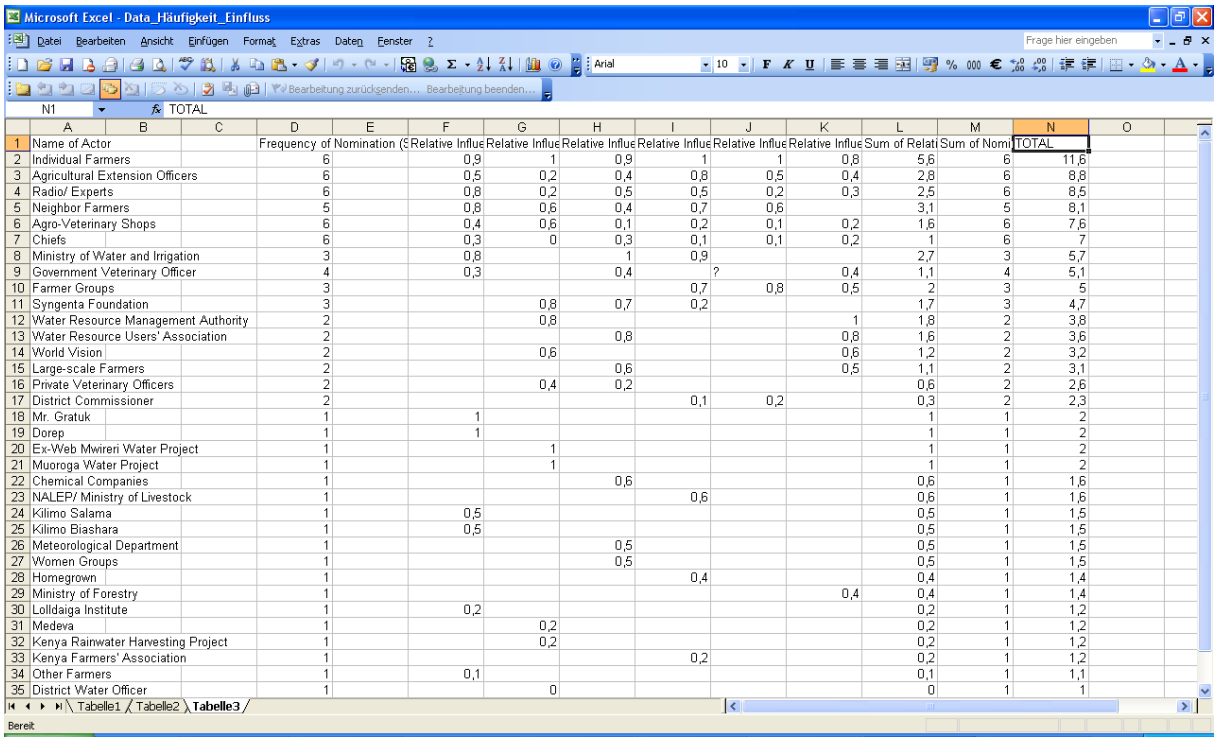
In order to find out who the core actors of this network are, the limits of the core network had to be defined. Limits which made sense in this context were limits which made an obvious relevance of an actor visible.

The core actors of a social opportunity network were therefore defined here by their relevance for the overall social opportunity network of the small-scale farmers. Their relevance was measured in a combination of the frequency of their mentions in the Net-Map discussions and the influence a particular actor had on the small-scale farmers' agricultural decisions. These two criteria, frequency of mentions and height of influence formed the limits for actors of the core social opportunity network of the interviewed farmers. An actor was defined a core network actor if the actor reached in the combination of the two afore mentioned criteria a simple majority.

In order to identify those actors, all nominated actors were entered into a Microsoft Excel sheet where the frequency of the actors' nominations (number of mentions) had been summed up in a first step and the relative influence of the actors had been summed up in a second step. Looking at 6 Net-Map discussions in total, the maximum possible number of mentions in all Net-Map discussions was 6, since 1 mention per Net-Map discussion was possible. The maximum possible number of relative influence was also 6, because the maximum number of relative influence an actor could have during one Net-Map discussion was 1 – and 6 in all Net-Map discussions. This means that the maximum possible number an actor could get in combining frequency of mentions and relative influence was 12, being 6 the maximum for both of the two criteria. In turn, this means that an actor had to reach a minimum of 6.1 points, which was the simple majority, in order to be a core actor by this definition.

To find out which actor had a simple majority in the combination of the two criteria the sum of the relative influence of an actor was added to the sum of their mentions on the Microsoft Excel sheet in a third step. The total was assorted in a descending order. The following screenshot shows how the core network actors were identified:

Figure 7: Identification of the social core opportunity network
by combining the frequency of mentions and the sum of relative influence of the network actors



Microsoft Excel - Data_Häufigkeit_Einfluss

N1: TOTAL

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Name of Actor			Frequency of Nomination (S		Relative Influe	Relative Influe	Relative Influe	Relative Influe	Relative Influe	Relative Influe	Sum of Relati	Sum of Nomi	TOTAL	
2	Individual Farmers			6		0,9	1	0,9	1	1	0,8	5,6	6	11,6	
3	Agricultural Extension Officers			6		0,5	0,2	0,4	0,8	0,5	0,4	2,8	6	8,8	
4	Radio/ Experts			6		0,8	0,2	0,5	0,5	0,2	0,3	2,5	6	8,5	
5	Neighbor Farmers			5		0,8	0,6	0,4	0,7	0,6		3,1	5	8,1	
6	Agro-Veterinary Shops			6		0,4	0,6	0,1	0,2	0,1	0,2	1,6	6	7,6	
7	Chiefs			6		0,3	0	0,3	0,1	0,1	0,2	1	6	7	
8	Ministry of Water and Irrigation			3		0,8		1	0,9			2,7	3	5,7	
9	Government Veterinary Officer			4		0,3		0,4		?	0,4	1,1	4	5,1	
10	Farmer Groups			3					0,7	0,8	0,5	2	3	5	
11	Syngenta Foundation			3			0,8	0,7	0,2			1,7	3	4,7	
12	Water Resource Management Authority			2			0,8				1	1,8	2	3,8	
13	Water Resource Users' Association			2				0,8			0,8	1,6	2	3,6	
14	World Vision			2			0,6				0,6	1,2	2	3,2	
15	Large-scale Farmers			2				0,6			0,5	1,1	2	3,1	
16	Private Veterinary Officers			2			0,4	0,2				0,6	2	2,6	
17	District Commissioner			2					0,1	0,2		0,3	2	2,3	
18	Mr. Gratuk			1		1						1	1	2	
19	Dorep			1		1						1	1	2	
20	Ex-Web Mwireri Water Project			1			1					1	1	2	
21	Muoroga Water Project			1			1					1	1	2	
22	Chemical Companies			1				0,6				0,6	1	1,6	
23	NALEP/ Ministry of Livestock			1					0,6			0,6	1	1,6	
24	Kilimo Salama			1		0,5						0,5	1	1,5	
25	Kilimo Biashara			1		0,5						0,5	1	1,5	
26	Meteorological Department			1				0,5				0,5	1	1,5	
27	Women Groups			1				0,5				0,5	1	1,5	
28	Homegrown			1					0,4			0,4	1	1,4	
29	Ministry of Forestry			1							0,4	0,4	1	1,4	
30	Lolldaiga Institute			1		0,2						0,2	1	1,2	
31	Medeva			1			0,2					0,2	1	1,2	
32	Kenya Rainwater Harvesting Project			1			0,2					0,2	1	1,2	
33	Kenya Farmers' Association			1					0,2			0,2	1	1,2	
34	Other Farmers			1		0,1						0,1	1	1,1	
35	District Water Officer			1			0					0	1	1	

Tabelle1 / Tabelle2 / Tabelle3

Bereit

Source: Screenshot by author

As can be seen, this method produced a list of core network actors (6.1 points to 12 points) and actors of the periphery (0 points – 6.0 points).

Analysis of the expert interviews

Furthermore, the 7 semi-structured expert interviews were analyzed with traditional methods of qualitative interview analysis. These methods included: Coding, Paraphrasing and finding thematic excerpts which explained social phenomena introduced by the small-scale agro-pastoralists, thematic comparisons of the expert interviews. The results however were only partly used where they were seen as a useful additional source of explanation. The data base had

already been sufficiently big and using even more data would have gone beyond the scope of this study. The 7 expert interviews were conducted between July 28th, 2011 and September 9th, 2011.

3.6 Equipment and technical devices

For developing pictures of the smallholders' agricultural network opportunities, for keeping track of the according process and for documenting this process, large unprepared flip-charts were used. The flip-charts were slowly filled with information in the course of the group discussion so that every participant could visually follow the process. For better visualization differently colored markers and post-its, specially prepared figurines, and locally available rubber gaskets were utilized. For the purpose of documentation a voice recorder and a camera were used, as well as a research diary. In order to store the electronic data, a flash disk and a laptop were finally utilized.

3.7 Ethical considerations

Before starting the field work some ethical considerations had to be taken into account and were discussed with different people supporting the research project.

3.7.1 Language barrier

One of the main obstacles for generating valid and sensible data during the field work was the language barrier which became manifest in the need for translation from Kiswahili into English and from Kikuyu into English – and sometimes vice versa. The local language being Kikuyu, most of the smallholders also spoke Kiswahili and some of them English. Since languages are closely related with social, cultural and ethical perceptions it was agreed that the interviews should be held in Kiswahili or in Kikuyu were people did not speak Kiswahili. Thus, the farmers were believed to discuss the matter before their specific cultural and ethical understandings and perceptions of the world – which by no means are believed to be the same even within a local community of smallholders. It was seen to be more sensible to hold the interviews in the local languages and later translate them into the research language English than vice versa. With the help of a translator the group discussions could eventually be followed by any participant not speaking Kiswahili or Kikuyu, as in the case of one researcher. Thus it was ensured that everybody involved into the process could also actively participate in it.

The problem of translation being solved, the problem of understanding remained. As already mentioned, language is always embedded into a social and cultural setting which at the same time creates and constructs the social reality of the speakers of this language. Terms like "influence" are understood very differently between two people, not to speak of ten people originating from different cultural and social settings and backgrounds. Research has shown that an accurate understanding of the "other" or the "exterior" is generally not possible, but a hermeneutic approach allows at least some degree of understanding. With this assumption in mind it was still tried to seek a mutual understanding of crucial technical terms of the Net-Map process, especially the terms "influence" and "enforcement". The problem was tackled by discussing these terms before the according phases of the Net-Map discussion began. Also, the over-arching question of the Net-Map process itself - "Who influences or influenced your agricultural decisions especially in years of extreme weather conditions like 2009/ 2011?" – was discussed before the process was started. The smallholders' views and perceptions of the according terms were taken into consideration and finally it was agreed on a common understanding of them.

3.7.2 'Over-researched' study area

Conducting research in a very well researched community can have some clear advantages – but it can also pose a threat to the results of the research. Problems might arise with the expectations of the interview partners especially in an area where people struggle to sustain their livelihoods. A research team coming from outside could be misinterpreted as a possible source of funding or of other forms of financial or technical assistance. This assumption and/ or perception about the researchers could thus influence the interview partners' answers and statements. Indeed during one Net-Map group discussion this could have been the case as the small-scale farmers insisted not to have had any relations to any other people or organization concerning their agricultural practices. The group repeatedly stated that they had never gotten any form of assistance, information or resource. In the course of the interview they slowly started talking about their links and relations. Taking the colonial history of Kenya into account, the fact that one of the researchers was not Kenyan but European could also have played a role for the farmers' hesitation. These thoughts were considered when interpreting the data as well as the coincidence that this particular group had the highest average age and that it was also the only group with illiterate participants. The combination of those factors and the fact that the area has seen

comparably many people coming from outside for either research or other purposes could be possible reasons for this groups' hesitant attitude.

4 Results and Discussion

The following chapter presents the results as well as the discussion of the results. Because of the disposition of the preceding analysis and its outcome, it was considered appropriate to combine the results and the discussion in one chapter.

The analysis generated a number of results:

The first result disproves the hypothesis of the study. (1) No correlation between the use of a certain type of social opportunity networks (formal or informal) and the adaptive capacities of the smallholders could be found. The groups “better off” did not have more formalized opportunity networks; likewise, the groups “worse off” did not use more informal networks and network opportunities. There was no evidence that there are decisive differences in the structures of the small-scale agro-pastoralists’ social opportunity networks following formal or informal patterns which could explain the differences in their adaptive capacities.

On the contrary, the second result shows that (with the exception of one group [wo1]) (2) all groups of smallholders exposed similar social network structures regardless of their perceived capability to deal with climate-induced shocks and threats like a drought. Group “worse off 1” showed a slightly different social opportunity network in structure, the network could be described as very small, informal and rather loose. During the group discussion it had become clear that the group did not really *want* to expose their social opportunity networks (see 3.7.2 ‘Over-researched’ study area). The deviance in the results of this group discussion is therefore interpreted against the backdrop of the groups’ hesitation to display their network connections.

The third result demonstrates that (3) not every actor in the farmers’ social opportunity networks seems to be of the same importance for the agricultural practices of the small-scale farmers, there are distinct differences. Some actors provided the farmers with a lot of information and resources while others did not - the tables of the actor analysis revealed this circumstance at a glance. Also, the intensity and the sort of influence which the listed actors had on the farmers’ agricultural decisions seemed to be quite different. The actors seemed to have different roles in and functions for the smallholders’ social opportunity networks. This, in turn, has different implications for the small-scale farmers’ capacities to adapt to climate variability and change. As outlined in chapter “2.3.2. Social networks”, the latter can have distinct advantages and disadvantages for the rural poor, social networks can enhance and/ or erode the smallholders’ social capital and thus their adaptive capacity. Among the benefits mentioned were for example: the provision of a safety net, the provision of information and economic resources, collaborative learning, advocacy to

influence policy or public debate, partnerships and work division. Among the dangers were social exclusion and power struggles. Most of these features were in one way or another found in the social opportunity networks of the smallholders.

The third result shall therefore further be explained and consequently discussed in the context of adaptive capacity to climate variability and change. Insights about the social opportunity networks' structure, their dynamics, their effects and the smallholders' access to certain network actors will be described in detail and their possible influence on the adaptive capacity of the small-scale farmers discussed on the following pages.

Regarding the structure and dynamics of the smallholders' social opportunities networks it was found that there is a "core" and a "periphery" in practically all networks. While the core usually consisted of the same actors, the actors of the periphery varied in most of the group discussions. In the following, the identified core network actors will be introduced and their position in and their function for the farmers' opportunity networks will be carved out, as well as their accessibility. Subsequently, it will be discussed how the found results influence the smallholders' capacities to deal with changes in and/ or variability of climatic conditions. Further, the actors of the periphery will be presented in order of their relevance as identified in the analysis. Actors of the periphery which have turned out to have a specific function or importance for the network will also be described in detail. The found results for the actors of the network periphery will also be discussed in the context of the smallholders' adaptive capacities to climate variability and change. Finally, an aggregated visualization of the small-scale agro-pastoralists' social opportunity networks will be presented.

The following table shows, in bold letters, the actors which constitute the core social opportunity network of the small-scale farmers in the study location. As explained in chapter "3.5 Data analysis", they have reached a simple majority in the sum of their total nominations and their relative influence on the smallholders' agricultural decisions. The actors which are not in bold letters are actors of the periphery that have not reached a simple majority in the two criteria for being part of the core network.

Table 3: List of core network actors

and actors of the network periphery in descending order

NAME OF ACTOR	Sum of Relative Influence	Sum of Nominations	TOTAL
Individual Farmers	**5.6**	**6**	**11.6**
Agricultural Extension Officers	**2.8**	**6**	**8.8**
Radio/ Experts	**2.5**	**6**	**8.5**
Neighbor Farmers	**3.1**	**5**	**8.1**
Agro-Veterinary Shops	**1.2**	**6**	**7.2**
Chiefs	**1**	**6**	**7**
Ministry of Water and Irrigation	2.7	3	5.7
Government Veterinary Officer	1.1	4	5.1
Farmer Groups	2	3	5
Syngenta Foundation	1.7	3	4.7
Mr. K.	1	3	4
Water Resource Management Authority	1.8	2	3.8
Water Resource Users Association	1.6	2	3.6
World Vision	1.2	2	3.2
Large-scale Farmers	1.1	2	3.1
Private Veterinary Officers	0.6	2	2.6
District Commissioner	0.3	2	2.3
Dorep	1	1	2
Ex-Web Mwireri Water Project	1	1	2
Muoroga Water Project	1	1	2
Chemical Companies	0.6	1	1.6
NALEP/ Ministry of Livestock	0.6	1	1.6
Kilimo Salama	0.5	1	1.5
Kilimo Biashara	0.5	1	1.5
Meteorological Department	0.5	1	1.5
Women Groups	0.5	1	1.5
Farm Care	0.4	1	1.4
Homegrown	0.4	1	1.4
Ministry of Forestry	0.4	1	1.4

NAME OF ACTOR	Sum of Relative Influence	Sum of Nominations	TOTAL
L. Institute	0.2	1	1.2
Medeva	0.2	1	1.2
Kenya Rainwater Harvesting Project	0.2	1	1.2
Kenya Farmers' Association	0.2	1	1.2
Member of Parliament	0.2	1	1.2
Other Farmers	0.1	1	1.1
District Water Officer	0	1	1

Source: Table compiled by author

4.1 The core opportunity network

The actors of the social core opportunity network were found in almost all group discussion and the influence they had on decisions regarding agricultural practices of the smallholders was considerably high in general. The actors' role in and function for the social opportunity network, as well as their accessibility have impacts on the network dynamics and on the network effects. These will be described and subsequently discussed before the background of adaptive capacity, looking at each actor in order of their relevance according to the list.

Individual Farmers

The Individual Farmers are the small-scale farmers themselves who were interviewed in this study. They are similar to the "ego" of "ego-centric" networks in traditional social network analysis, but since the study is handling aggregated data, this nomination is incorrect. The farmers identified themselves as the most relevant actors in their opportunity networks, a self-explanatory fact since the whole analysis is about their own social networks. Individual Farmers have been nominated 6 times (out of 6) and they have been allocated 5.6 points (out of 6) when asked to evaluate their influence on their own agricultural decisions. The farmers indicated that they give themselves information and advice. This information is gained every time when they are cultivating and harvesting, especially when experimenting with new or different techniques, seeds or with livestock breeding. From the results they see on their farms they take advice for the next cycle of cultivation. They add these information and advice to their pool of experiential

knowledge which they are constantly amplifying and reshaping and eventually they make their decisions based on it:

> What I can say is we have helped ourselves in the area of farming, first, our farms are small, so in our keeping of livestock you yourself you think and decide that this is an area of drought, you realize it's not possible to keep many livestock, you decide you keep one livestock that you can feed even when there is drought and rains […]. On the side of farming you decide as a farmer yourself […] that if you plant a maize variety of 5 or 6 months [of maturing, author's note] you decide to keep a bag of 'Katumani' [maize variety that matures in 2 or 3 months, author's note] because when the long series crops can fail because of lack of rains, but you get to harvest 'Katumani'. If you loose the long series crop, at least you will eat from the short series ones. Even though it has become too much, because even when you plant that 'Katumani', there are times you can get nothing to eat. Now, we're continuing to suffer. Even your own decision has reached a level where your own decision does not help you. (Person X, Transcript control group, p.2/3)

Another farmer describes the process of trial and error as follows:

> In my view one of the problems we face, though we are also assisted by external actors, is a situation whereby we teach ourselves out of the problems we go through. For instance, you plant a certain type of seed and it fails, particularly for the period we are talking about I have tried two types of seed, there is the type we have been provided with by extension officers as short-terms crops that I planted on one part of the farm and the long-term crops that I planted on the other part so that once the rains disappear in such a way that the long-term crops cannot survive then you benefit from the short-term and if the rains continue you benefit from both. (Person 4, Transcript bo1, p.13/14)

The farmers' ability to observe closely what happens on their farms and on their neighbors' farms during a cultivation circle adds to their experiential knowledge and influences further decisions:

> Let me say that since 2008 although the situation worsened in 2009 the climatic conditions in the area seem to have changed a lot. As a matter of fact, even the months we would expect rains to come, say April when we were used to plant, these days the rains may come as early as in March. This was the case this year and even last year. Therefore there is something I've come to realize, that is, those that plant early before the rains, the seeds are able to wait for rainfall. Those people who plant earlier rarely lack some produce. (Person 1, Transcript bo1, p.15)

This phenomenon is also true for other areas of agriculture:

> **Interviewer:** So you have also taught yourself on how to manage crop diseases?
>
> **Person 3:** Yes I have, on top of what Mr. K. taught us. (Person 3, Transcript wo2, p.4)

Experiential knowledge is of utmost importance in an area where it is hard to come about other forms of gaining additional agricultural knowledge. For the further discussion, the term knowledge has to be defined here briefly:

> Knowledge can be understood as both information and skills that are acquired through individual experience and trial and error, within an organization or a learning community, or from outsiders adapting it to local contexts. Knowledge that rural and farming communities are typically interested in includes cultural management practices; new agricultural technologies; diagnostic information about plant and animal disease and soil related problems; market information on inputs and sales (prices, seller, buyers, retailers); market demand and quality of products required for these markets; and land records and government policies. (Hartwich et al. 2007: 22)

Experiential knowledge, 'trial and error' and learning by doing have been described as 'tacit knowledge' in the literature about knowledge management. In this regard 'explicit knowledge' is knowledge "that can be codified and articulated in formal language" (Polanyi 1966 in Hartwich et al. 2007: 22). While the analysis revealed a relatively high degree of tacit knowledge among the small-scale agro-pastoralists, a general lack of explicit knowledge could be observed. Most of the interviewed farmers do not have any specific agricultural education since they lack the financial ability and because such institutions are locally not available. Experience and experiments have been the practical reality of the small-scale farmers ever since they first settled in the area. Coming from other areas, they had not been familiar with the specific climatic, hydrologic and geologic conditions of the Laikipia plateau. Over the years, they have gathered a broad agricultural knowledge and a vital understanding of the local climatic conditions. The smallholders have a system of gathering information through the principles of 'trial and error' and 'learning by doing', which have some distinct advantages in the light of adaptive capacity – as well as undeniable disadvantages.

First of all, tacit and explicit knowledge can help enhancing the smallholders' practice of networking and thus their adaptive capacity. The more experience a farmer has the better she or he will be able to critically examine the content of information and the source of information. The Individual Farmers are at the very centre of the core network. They are the checking instances and the controlling mechanisms of their opportunity networks. Their ability to check, evaluate and consider every other actor in their network depends greatly on their own knowledge, especially in agricultural matters. The more knowledge they have, the more efficient they can be in making the best use of their own networks because they know what they are looking for and they know where at best to get it from. They can gain more relevant information and advice and maybe even more resources. A great pool of knowledge – and not only of technical but also of experiential knowledge – also enables the smallholders to control how much influence any other actor in their social opportunity networks has on their own decisions. Actors which appear more trustworthy than others can be selected, actors which seem of little use or even hindering their farming matters, can be circumvented. This kind of knowledge greatly

determines the farmers' capability of networking. Successful networking, in turn, is crucial for adapting to climate variability and change.

Another positive effect of gaining tacit knowledge in the form of 'trial and error' and 'learning by doing' is that it is locally adapted in contrast to farming practices and methods which are developed in comparable but different regions with different preconditions. Therefore, in the light of climate variability in change, it has a higher sustainable component and can thus probably be regarded as positive for the farmers' adaptive capacity.

'Trial and error' can further foster the farmers' adaptive capacity because it may lead to a higher level of flexibility. Even if not voluntarily, 'trial and error' calls for a relatively high readiness to take risks and it necessitates the smallholders to sustain a high grade of flexibility. This flexibility is reflected in the spontaneous and/ or reactive ability to change their thinking and/ or behavior, in the process of anticipation and in deliberate forward planning.

Another positive effect of 'trial and error' is that it activates creativity and can thus be an impetus for innovation. Following Monge, Hartwich and Halgin (2008), innovation here is understood as "anything new successfully incorporated into social or economic processes" (Monge/ Hartwich/ Halgin 2008: 3). Regarding innovation, the analysis of the opportunity networks revealed a lot about the farmers' readiness and openness for experiments. Especially where they have a way of buffering or compensating possible risks, it can be said that the smallholders' capacity and willingness to foster innovation is quite high, many of them are ready to alter existing practices, resources and behavior, or to adopt new ones. A difficulty for innovation is the practical implementation which hinders successful sustainable innovation and thus adaptation to climate variability and change. Further, an environment of compulsion is probably not the most suitable for sustainable innovations in the light of climate variability and change. Innovation originating from a structural deficiency (e.g. the lack of explicit knowledge) might rather be responsive to short-term shocks and might not provide long-term solutions. Also, restraints stemming from the lack of financial assets are likely to hinder the farmers' innovative energy since there is hardly any economic coverage for taking risks not speaking of capital for investments.

Negative aspects of the principles of 'trial and error' and 'learning by doing' might occur in times of extreme climatic events such as drought and in this respect erode the smallholders' adaptive capacity. An 'error' could mean crop failure and/ or livestock loss and consequently lead to a severe threat to the farmers' livelihoods. The aforementioned compulsion to take higher

risks might in this case have disastrous consequences for the smallholders who do usually not have enough financial capital to buffer the consequences.

The phenomenon of climate variability further puts the small-scale farmers' experiential knowledge into question when it occurs in frequent droughts, in prolonged dry spells, in failure of rains, or in rains during dry seasons, which might even lead to floods. According to the farmers, until recently they could rely on the more or less regular interplay of rainy and dry seasons during the circle of year. They have experience with the failure of the rains but they expressed their doubts in their own experiential knowledge as in many cases it does not seem to hold true anymore. This uncertainty or this distrust in their own knowledge and in their decisions has repeatedly been stated and contributes to the farmers' strong wish for other reliable information on climate and the actual weather forecast as well as on agricultural matters and practices.

Agricultural Extension Officers

Agricultural Extension Officers are employed by the Kenyan government unless they work for the private sector. Among their main responsibilities are the dissemination of agricultural information and the training of farmers on agricultural and livestock oriented issues:

> […] Since we don't have the livestock personnel, we are carrying out both agricultural and livestock oriented activities. (Agricultural Extension Officer, Transcript Agricultural Extension, p.2)

The Agricultural Extension Officers have been mentioned in every Net-Map discussion (6 out of 6), but their influence on farmers' agricultural decisions has been ranked only half as high as the farmers own influence on their decisions (2.8 out of 5.8). This is surprising since it is the Agricultural Extension Officers' function to educate and train farmers on agricultural matters. One would assume that they are the most important sources of information to the farmers, especially in comparison to the other core network actors. The analysis of the link "information and advice" explains these slightly opposing results. On the one hand, the Agricultural Extension Officers provide the farmers with the most information and advice in relation to any other actor of the network. Additionally, the Agricultural Extension Officers provide the farmers with comparatively more significant information in relation to the other actors as regards content. They are viewed as experts by the farmers:

> [Group] gives the agricultural extension officer 4, because they see him also as an expert like the government veterinary officer. (Translator's note, Transcript mo1, p.24)

But on the other hand the farmers view the Agricultural Extension Officers also as experts who have a lot of potential knowledge to which the farmers do not have access the way they want and need to. They criticize that the Agricultural Extension Service is not sufficient in the area anymore – and say that it used to be different in former times.

> We actually learnt from agricultural extension officers, though nowadays they are hard to come about. (Person 6, Transcript bo1, p.8)

> On the side of crop farming I can say that people here use their own knowledge because if we were to use the agricultural extension officers it would not be reliable because they are not always available neither are they available during all seasons. (Person 4, Transcript bo1, p.14)

> **Interviewer:** Do you still have an agricultural extension officer in this area?
>
> **Person 4:** No, but we usually have some maybe when the chief is addressing a 'baraza' [Kiswahili term for a public meeting called by the chief, author's note]. (Person 4, Transcript wo2, p.6)

> The agricultural extension officer guides us but not always, only when he is around. (Person 3, Transcript wo1, p.12)

It becomes clear that the link "information and advice" does exist between the Agricultural Extension Officers and the Individual Farmers, but the link has a lot of more potential and the farmers wish the flow of information and advice was more and more frequent.

The insufficient availability of the Agricultural Extension Officers of today is an important reason why the farmers rate the influence they have on their agricultural decisions rather low. They have seen other times, especially those farmers who repeatedly reported about the former Agricultural Extension Officer of the area, Mr. K. He has been mentioned in half of all Net-Map discussions (3 out of 6), his information and advice was predominantly agro-technical and included advice on crop and livestock farming, on management of a farm and on sustainable use of natural resources. Unlike Agricultural Extension Officers today, whose number has shrunk greatly after a cut in government spending and a turn in their policy, Mr. K. was around all the time:

> This man used to go round the farms every day, such that even if he found you in the house he would request that you take him round your farm. He taught us a lot. (Person 4, Transcript mo2, p.4)

Beside his frequent presence and constant availability, the farmers emphasize on his personal engagement for the farmers' needs and his special commitment in his work with the farmers:

> What I may say is that I have been in this area since 1988, we were mostly engaged with the extension officer called K., he was really trying to assist people here, because he was visiting farmers door to door and he would inquire from the farmers the problems they were experiencing as they tried to do farming. (Person 4, Transcript wo2, p.5)

> He would go out of his way to get for us seeds and then I think he was able to present good reports to government offices and thus he was always considered. (Person 7, Transcript bo1, p.23)

> **Person 1**: Mr. K. wanted us to inform him of our problems and he would advice us accordingly.
>
> **Interviewer**: So is Mr. K. still around?
>
> **Person 5**: No, they are saying he was transferred.
>
> **Person 7**: But we are still looking for him. (Transcript bo1, p.20)

> For the work Mr. K. has done for us here I would give him 10 [points in allocating influence on their agricultural decisions, author's note], too, because even if he is no longer here he did for us great work... We were even motivated to do cultivation because we even had shows in the area whereby different farmers in the location would display their produce, such that on seeing what other farmers were producing one was prompted to work even harder. He even gave some of us prizes. (Person1, Transcript bo1, p.27/28)

Not only Mr. K.'s personal commitment and value is repeatedly stated but also the usefulness of his advice until today.

> We want to give him [Mr. K., author's note] 10 [points in allocating influence on their agricultural decisions, author's note], because we are still able to use what he taught us, even though he is no longer in the area. You must have heard Person 1 talk about how to prevent soil erosion and the fact that she still eats [cultivates, author's note] the bananas she planted then. (Person 4, Transcript bo1, p.27)

The actor Mr. K. is a peculiarity of the core opportunity network. In his case the farmers clearly distinguished between the person behind the actor and his role as an Agricultural Extension Officer. They repeatedly pointed out his importance for their ability to get solid information and helpful advice in agricultural matters. The reasons for his popularity and importance up to today - although he is not even an *active* actor anymore - are his constant availability, his outstanding commitment and engagement for the farmers' concerns and his profound agricultural knowledge.

This is what the farmers expect from an Agricultural Extension Officer and these factors seem to define the level of confidence they have in the Agricultural Extension Officer.

The analysis of the link “resources” shows that the small-scale farmers do sometimes get seeds from the Agricultural Extension Officers. These seeds are given by the Ministry of Agriculture and are part of their strategy to persuade the farmers to cultivate crops which are drought resistant, better adapted to the area and less water consuming than for example a lot of maize varieties which are traditionally grown. The Agricultural Extension Officers give the farmers 1 kg of, for instance, millet or sorghum or a short-term maize variety for free which the farmers then cultivate, and on harvesting they have to give back 1 kg of their harvest to the Agricultural Extension Officer which in a next step will be given to another farmer.

The Agricultural Extension Officers do not have the authority to exert any enforcement on the smallholders; therefore this link can be neglected here.

It can be said that the Agricultural Extension Officers are potentially the most important source of agricultural information and advice for the farmers. They bring new technologies and other agricultural innovations to the farmers, they are viewed as experts and their advice in general as trustworthy. Since the small-scale farmers cannot afford to consult private agricultural extension services they heavily depend on the Agricultural Extension Officers. An expert interview with an official of the National Farmers Information Service (NAFIS) explained the reasons for the missing Agricultural Extension Officers: According to the expert, the Kenyan Government could not afford to maintain the Agricultural Extension Service as it used to be. The policy was changed and it was tried to shift the Agricultural Extension Service from supply-driven to demand-driven and replace, where possible, public extension with private extension. They stopped employing Agricultural Extension Officers on a broad basis, nowadays one Extension Officer has to care for roughly 2,000 – 4,000 farmers which makes individual farm visits hardly possible anymore (cp. Transcript NAFIS, pp.4 - 6).

The transfer of Mr. K. to another site meant the loss of valuable social capital and of a vital source of explicit knowledge to the small-scale farmers. The agricultural extension officers who are now working in the area are well trained too, but there are simply not enough of them. Where they reach the farmers they have most relevant agricultural information and knowledge which the farmers need in order to successfully adapt to a changing environment. But the policy change of Kenya’s government which came with large expenditure cuts in the agricultural extension system has left a delicate structural hole in the smallholders’ social opportunity holes. The lack

of sufficient governmental agricultural extension officers is a structural hole in the farmers' social opportunity networks and thus a big obstacle for their adaptive capacity. It can currently not be compensated by the private extension sector as the smallholders lack the financial ability to engage them.

Radio/ Experts

In every group discussion the media were said to play a role for the farmers to gather agricultural information. While television was only mentioned once and newspapers or the internet never, the radio was restated in every single discussion (6 out of 6). The radio itself being just the medium, it was further investigated who the farmers thought that the people behind the radio programs are. In the group discussion of group "mo1" they were identified as follows:

> It's like the radio invites specialists from the agricultural department and interview them [….]. (Person 1, Transcript mo1, p.7)

Indeed there are different actors behind the radio: There is the Meteorological Department which gives out information about the day-to-day weather as well as about the seasonal climatic development. There are other governmental and private institutions which give out agricultural information in special programs or interviews, for example which type of seeds to plant in relation to the area and to the seasonal forecast. And there are advertisements that can be heard on the radio which inform about specific agricultural products and how to use them, like chemical companies that talk about crop diseases and the treatment of them.

> […] there are times you may hear Dorep [large-scale poultry production firm, author's note] experts in a radio program. (Person 7, Transcript bo1, p.22)

> The chief may also make an announcement through the radio for an issue affecting his location. Syngenta as a company usually sends experts to radio stations to teach farmers on various issues, for instance chemicals and when to use them. They also advertise their products. (Person 1, Transcript mo2, p.9)

There is a big variety of actors behind the radio which all come together in the respective local or national broadcast stations. Here it is decided which information is to be transmitted and which is not. Therefore, the actual actors in this case would be the different broadcast stations, but the farmers did not identify them as such. Also, within the scope of this thesis it would neither be possible to examine all those stations, their principles and their intentions, nor would it effective

for the analysis at hand. The farmers identified “the radio” as an actor, they did not distinguish between the broadcast stations or the actors behind – apart from the Meteorological Department which was mentioned once. Since this analysis is about the small-scale farmers’ opportunity networks and how they perceive it, the medium “radio” will be handled as an actor here.

The radio is a very important medium in the region for broadcasting agricultural information to the farmers:

> **Person 6:** For me I give the radio 8 [points in allocating influence on their agricultural decisions, author’s note] because it has taught us a lot.
>
> **Interviewer:** But has the radio in any way changed your agricultural practices?
>
> **Person 7:** Yes, because we don't have another source of information other than the radio. Even the weather forecast program is broadcasted over the radio and this has changed our practices a lot. For many people you will hear them refer to the announcements like ‘there will be drought and farmers are advised to plant short-term crops for the rains will be minimal’. (Transcript bo1, p.29)

The access to this source of information is comparatively easy and most farmers can afford a radio. Also, there is a plentitude of agricultural programs on the radio:

> […] They really teach us on a daily basis.” (Person 6, Transcript bo1, p.29)

This is even more important in a rural setting where electricity is scarce or absent and where agricultural information in written form is extremely hard to come by. In addition, listening to a radio program does not take extra time but can be done during working. As with the Agricultural Extension Officers it was not the resources but the possibility of getting new information which makes the radio a valuable actor for their social opportunity network. But the farmers also criticized the low level of reliability regarding weather forecasts and seasonal forecasts which is essential for the right time of planting and harvesting:

> We usually do not follow the radio, even when they say there is no rain we go on with planting, because we believe that it is God who gives rain. (Person 3, Transcript wo1, p.19)

> Maybe the radio, it may for instance say that this year we expect low rainfall, though they may say that it is going to be low rainfall, but it turns out that it is heavy and they may say it is going to rain and it fails to. (Person 1, Transcript wo2, p.11)

Despite the low reliability of the meteorological and climatologic forecasts, the farmers also find fault with the radio giving out information but eventually not assuming responsibility for these information.

> **Person 1:** We give the radio 3 [points in allocating influence on their agricultural decisions, author's note], they just talk but do not act.
>
> **Person 2:** They just inform us and leave us with questions. (Transcript wo2, p.22)

> The radio gets 1 [point in allocating influence on their agricultural decisions, author's note], because they just talk and then go but they never bother if the farmer got the message. (Person 1, Transcript mo2, p.15)

This is indeed a problem which was approved by the current Agricultural Extension Officer of the region:

> **Agricultural Extension Officer**: So, when the radio is teaching, maybe, for clarification, the farmer may come to me and ask: 'What I heard, is it in order, or do we have such things here…?' […] The information will always be gotten wherever it will be gotten. But you can not refuse the farmer to adopt whichever he or she wants to. But now, what we normally tell them, even if you are going for that adoption, take caution. For instance the case of jet rover, Jet rover when it was introduced here, and most farmers went, bought and planted.
>
> **Interviewer:** Jet rover is what?
>
> **Person 1:** It is this plant that is said to produce diesel.
>
> **Interviewer:** Ok! Bio-Fuel?
>
> **Person 1:** Yes. So the people went there, they learnt about it, they heard in the radio, they followed up through the contact that they gave, bought, without consulting other offices, and they planted. So, when it backfired, it is when they will come to us. You know, even if it is in my area, I do not always know what is happening there. So they would come to tell me that they had planted it, now for eight months, and it is still on the ground [very short, author's note], you see, and it is costly, so you just advice them and tell them to always consult our office. So that at least they can be able to link up with other people so that we can be able to see whether it can do well here or it can not. (Transcript Agricultural Extension Officer, p.12/13)

On the other hand there are programs where the farmers have the possibility to talk to the people behind the programs:

> **Person 2:** We get information from the radio and we are also able to ask questions by calling them or through sms [Short Message Service, author's note].
>
> **Interviewer:** So they can ask questions about a particular context like for seedlings, they call or sms?
>
> **Person 7:** There are experts who ask you where you live and according to that they can identify the soils and advice you on which seeds to plant. These experts are available more than once a week from different radio stations. (Transcript bo1, p.21)

So, even though the farmers' opinions differ on the reliability of the information which they get from radio programs, be it on agricultural or on meteorological issues, the influence of this medium is not to be underestimated. The farmers allocated a sum of 2.5 points of influence on

their agricultural decisions to them, but as the farmer statements differ, so do their opinions and with them the points allocated between the 6 groups. There are literally no resources which the radio stations give to the farmers or vice versa, apart from some occasional raffles or games where there are prizes to be won. The same accounts for the link enforcement, there is none to be found. Accordingly, it is neither the resources the farmers get from the radio, nor any form of enforcement which constitutes the value of this actor for the farmers' opportunity network. In this case it is the mere fact of the radio being a medium which gives the farmers access to a broad pool of different information and advice. This means that the radio's function for the opportunity networks is a mere informative one. The radio, respectively the broadcast stations and the actors behind them, offer an additional source of new information in a context of scarcity of agricultural information. The access to these information is comparatively easy, the actor Radio has to highest potential availability in this research. The radio plays a role as a distributor of innovations – but the effects of their distribution might not always be beneficial for the farmers as we have seen in the statement of the Agricultural Extension Officer. Even if the radio does provide the farmers with important information on market prices, on weather, on climate and on agricultural innovations, as with all media their influence on the farmers' agricultural decisions can also be counterproductive.

The radio is a complex mixture of social and human capital and the information spread by the radio has to be viewed critically. The agricultural programs broadcasted by different radio stations offer a comparatively cheap and easily accessible source of information. The radio stations can on the one hand transmit information about new technologies or seed varieties etc. and thus enhance the farmers' adaptive capacity. They can also hinder adaptive capacity where the information is misinterpret or applied without any further knowledge and assistance. Additionally it can be assumed that agricultural education especially in the rural context of small-scale farmers is best communicated if it is "touchable". This means that the social learning process of the farmers is more effective if they can actually see and feel what is done on the fields instead of merely hear about it in the radio.

Neighbor Farmers

The farmers who live in the same or in adjacent villages of the area were identified as Neighbor Farmers. The interviewed small-scale farmers usually saw their neighboring farmers more or less identical to themselves in the context of farming:

> Give the neighbor farmers 9, because they are basically the same as we are, all farmers. (Person 5, Transcript mo1, p.23)

The Neighbor Farmers were mentioned in 5 group discussions (out of 6) and they were allocated an overall influence on the agricultural decisions of the Individual Farmers of 3.1 points. This rating of influence is the second highest after the farmers' own influence on their decisions. The Neighbor Farmers are often the Individual Farmers' families, friends and their social backing. They are in the farmers' perceptions among the most reliable sources of information, advice and of resources – in many cases they are the farmers' last resorts. This is reflected in the links the farmers have among each other. Beside the manifold kinds of agricultural information which they interchange, the link resources has not been mentioned as frequent and varied in connection with any other actor than with the Neighbor Farmers:

> The neighbor farmers are the actors that give us a lot of things for example we share advice, in case you don't have seeds [mainly after crop failure, author's note] you can share a lot of things, even if you are not connected to piped water you can share with them... These are the people we share with a lot. (Person 7, Transcript bo1, p.23)

> **Person 3:** Yes, there is an exchange of information for example farmers can exchange on inputs like fertilizers. In many cases when a neighbor farmer visits you, you share with them resourceful information.
>
> **Person 2:** They will ask 'where did you get this from?' For instance, I have some potatoes that neighbors found me harvesting and they were actually inquiring where I had obtained it from because what I was having would not be enough for me and for them too.
>
> **Interviewer:** And is it one way or two ways?
>
> **Person 2:** Normally, when a neighbor farmer visits you, you always advise them appropriately because on asking you, we respond according to the best of our knowledge. (Transcript bo2, p.14/15)

> Also, concerning the neighbor farmers, they may approach you, requesting for seeds of a crop that you harvested well, and that's two way. (Person 4, Transcript mo1, p.18)

Of course there are also cases of distrust to be found - as in any other social entity.

> Take the example of my neighbor farmer and me, I usually plant in a certain way and he does in his own way, in case I advised him on how to do it he usually does not trust me, he goes on to do it his own way using his own knowledge. (Person 2, Transcript mo1, p.3)

There are other cases of distrust and envy reported, but even a group which insisted that all of them did not interchange agricultural information with their Neighbor Farmers stated that they do share seeds in cases of emergency:

> No, we don't consult with the neighbor, everyone buys what they want because if you follow what the neighbor has done you may get confused. (Person 6, Transcript wo1, p.5)

> We also can give the neighbor farmers resources such as seeds if they do not have [any]. (Person 2, Transcript wo1, p.15)

The high influence the Neighbor Farmers have is explained as follows:

> Let's give them 7 [points in allocating influence on their agricultural decisions, author's note], because, take Person 5 as my neighbor farmer. If I visited him and found out that he cultivated a crop that had done very well, I will have to go and try it out, hoping it will assist me. (Person 1, Transcript mo2, p.15)

> I mostly learn from what my neighbor farmers do, for instance, if they plant in a certain productive way I go and try it in my farm. (Person 4, Transcript mo1, p.9)

Overall it can be said that the farmers do rely heavily on each other concerning resources and to a lesser extent concerning agricultural advice. The access to the Neighbor Farmers is very easy and the accessibility of them is high. There is a lot of interaction between the Individual Farmers and their Neighbor Farmers on a day-to-day basis. Helping each other out is a principle which guarantees their economic and in some cases even physical survival. It is a mostly balanced principle or strategy of give and take, which the farmers use as a channel of interaction. The Neighbor Farmers' most important function is therefore that they constitute a constant resort of interchanging information and resources as well as a last resort in times of emergency.

Agro-Veterinary Shops

Agro-Veterinary Shops sell agricultural materials and equipment like fertilizers, pesticides, fungicides, herbicides, seeds, animal feed, agricultural implements, technological tools and tool kits. The farmers mentioned the Agro-Veterinary Shops 6 times (out of 6) and allocated them a total of 1.6 "influence points". The analysis of the six interviews revealed that the farmers view the Agro-Veterinary Shops quite critically:

> **Person 1:** Let's give them 2 [points in allocating influence on their agricultural decisions, author's note], because if I lacked money, that one cannot assist me.

> **Person 3:** If I don't have money I cannot get any influence from them. For fertilizers, seeds etc. I have to pay.
>
> **Interviewer:** And how does this influence your agricultural practices?
>
> **Person 3:** If I buy seeds from them I get high produce, if I buy chemicals I am able to spray and my crops do well.
>
> **Interviewer:** So we give them 2, because their influence is quite low?
>
> **Person 3:** Yes, it's only that I did not have ability. Were I able to make my own seeds we would never meet with them. (Transcript wo2, p.24)

The farmers exposed a certain mistrust regarding the information they get from the Agro-Veterinary Shops:

> Yes we do get their views on the crop that may perform well in our area, but again we don't follow, because it all depends on the weather here. We also inform them how the seeds we buy from them perform. (Person 6, Transcript wo1, p.14)

> The agro-vet is a business, when you give them the money the business is done [laughter]. (Person 2, Transcript wo1, p.15)

The latter statement resembles quite clearly what most farmers in the interviews expressed in one way or the other. The main goal of the shops is their business, therefore the farmers try to view the information they get from the Agro-Veterinary shops on agricultural implements critically. But since they lack a broad variety of sources where they can get additional or alternative information on products, they are often forced to simply follow the advice of the shop-keepers.

The Agro-Veterinary Shops provide the farmers with information and advice on the products which they sell and are in this context a powerful information source.

> They deserve 4 [points in allocating influence on their agricultural decisions, author's note] because you may go to the shops to buy e.g. '[…?]' to fight blight, but the agro-vet may respond buy asking you to use '[…?]' instead because it is stronger on which you agree very fast and on using it you realize, that it was very effective. And even with livestock medicine even if you tell him what you want, they can advise you on the best medicine, because they are experts. (Person 3, Transcript bo2, p.22)

What is more, these shops are the farmers' most important source of resource supply when there is no situation of emergency. Nearly all the seeds they use are derived from the shops, unless the farmers plant out of their own harvests. Also, all chemicals and lots of the fertilizers and other implements are bought in these shops, the farmers did not mention any other important source of supply in this respect. This means there is quite some dependence on information and resources

from the shops on the farmers' side. The lack of additional information and resources does not give the farmers choices and options, for example if we think of organic farming or the like. In this respect it can be said that the shops can also hinder new developments in the area, despite the assumption that Agro-Veterinary Shops are among the most important sources of distributing new technologies to their buyers. They do of course, but only those innovations and new technologies of companies they are subcontractors of. The variety of shops is small and there are not many alternatives.

Chiefs

The last actors of the core social opportunity network are the Chiefs. The Chiefs are part of the core actor network even though the influence they have on the farmers' decisions in agricultural matters seems to be quite low - they have been allocated 1 point in total. But they have been mentioned in every Net-Map discussion (6 out of 6) and they actually do play a very important role for the farmers' social opportunity network, as we will see. All in all the farmers stated that the Chiefs usually do not provide them with agricultural information or advice per se. The only agricultural advice mentioned was on planting Aloe Vera and trees:

> **Person 1:** Well, he [the Chief, author's note] tells us to plant Aloe Vera [laughter]. His meetings are usually on Aloe Vera.
>
> **Interviewer:** Why do you think he tells you to plant Aloe Vera?
>
> **Person 1:** Surely, when people are facing hunger, telling them to plant Aloe Vera cannot work, even if it is said that it can fetch a lot of money you may wait only to find out that even the market is not available. For those who have planted I have not heard those that have gained any profit.
>
> **Person 6:** He also advises us to plant trees […] to attract rainfall and also to provide firewood instead of people destroying other peoples` trees or cutting from "wazungus" [plural for 'mzungu': Kiswahili term for a person of foreign descent, here used to describe white/ European owners of large estates, author's note] land […]. (Transcript bo1, p.17)

Since the Chiefs did either not give agricultural information and advice at all, or advice which the farmers do not consider useful enough, the farmers did not allocate them high numbers of influence on their agricultural decisions. Additionally, they usually do not receive resources from the Chiefs which could make them "more valuable", in this regard. The Chiefs are the only actors in this analysis so far who have the authority to and who do exert enforcement on the farmers' agricultural decisions. But the enforcement was only reported where the farmers cut down trees without permission (cp. Transcript mo2, p.12). Therefore it can be considered

negligible here. What makes the Chiefs very important actors for the core opportunity is their connective capacity. The farmers continuously reported that a Chief is the entrance point to a community and any organization from outside, be it an NGO or the Agricultural Extension Officers, usually contact the Chief first. The Chiefs themselves have in general a bigger social network than most other small-scale farmers and it would be very interesting to further analyze these networks especially in relation to enlarging the small-scale farmers' opportunity networks. The analysis here revealed that the farmers know very well about this function of the Chiefs, but they do not value it important for their agricultural practice:

> It's good to speak the truth, though truth is bitter. There is actually no assistance [by the Chief, author's note]. However, if there is any, not unless the chief had organized with department officers who are planning to visit the area though this is not common in the recent past. (Person 1, Transcript bo1, p.16)

Especially the connection between the Chiefs and the Agricultural Extension Officers is very interesting:

> On the other hand the agricultural extension officer may request the chief to call a chief's 'baraza' in order for the extension officer to get an avenue of addressing a certain problem. The agricultural extension officer does not have the authority to convene a 'baraza'. (Person 7, Transcript bo1, p.20/21)

For the Agricultural Extension Officers it is very difficult to organize group meetings for the farmers on their own initiative because they do not have an established way of calling a meeting. Thus, they ask the Chief to call a 'baraza' where they can speak to a big audience. A Chief's 'baraza' is an old social tradition with important functions for community life and has its own established rules.

But the Chiefs are not only knowledge brokers, but they are also resource brokers. Firstly, they are an access point to different kinds of government support. Most importantly, relief food is given by the government but distributed by the Chiefs. Especially in times of drought, crop failure and hunger the small-scale farmers know they can rely on the Chief to get relief food and/ or relief seeds for them.

> […] when there is drought we go to him [the chief, author's note] to report that we may die. [Group is laughing.] Thereby the chief is able to look for ways of getting relief for us. (Person 3, Transcript mo1, p.20/21)

Not only relief food and seeds are distributed through the Chief:

> The chiefs store usually always have something, there is that for the very old, the disabled, all those issues are dealt with by the chief. (Person 2, Transcript wo2, p.16)

Additionally, in other cases of shortage and need the Chiefs may provide further assistance to the farmers using their social position and their social network:

> Normally there are certain problems that we encounter. There are times when it is very difficult to obtain firewood yet people that own land that has forests are the 'wazungus' and no one is allowed in, not unless people organize themselves and request the chief or councilor to intervene. These lead the people to the 'wazungus' to request for permission to access firewood. If the 'wazungus' accept then the people are given instructions on how to go about it. That is they shall not cut trees, not to carry 'pangas' [Kiswahili term for traditional big knifes, author's note], axes and they are just required to collect wood lying on the ground. (Person 6, Transcript bo1, p.17)

Finally, the Chiefs also help to solve conflicts. In the context of a lack of water, this mediating function of the Chief can also be considered relevant for the farmers' agricultural practice.

> Also when our village members do not adhere to the rules of maintaining water in the river the chief tries to bring them back to the rules because the chief knows when the water disappears from the river, we will be finished. (Person X, Transcript control group, p.5)

Even though the small-scale farmers do not regard the Chiefs important for their agricultural decision, they are eventually. They play a crucial role in the farmers' social opportunity networks as knowledge and resource brokers. They bring people from outside into the communities and organize ways for the exchange of information and resources. Their traditional and natural authority can help in distributing information and implementing new technologies. Also, the mediation of conflicts is a very important function of an actor for a network as a whole. Interestingly, the role of the chiefs in the networks seems to be positive for the farmers' adaptive capacity – as long as they do not take advantage of their positions of power. But their functions as knowledge and resource brokers in the social opportunity networks can lead to better access to donors, last resorts, (government) institutions and NGOs. They can build bridges for information as well as for resources which in turn positively affect the farmers' possibilities for adaptations and thus enhance their adaptive capacity. In case the chiefs utilize their strategic power positions in the networks and control or pass on resources and information selectively they can also have adverse effects to the farmers' adaptive capacity.

4.2 Peripheral opportunity network

As mentioned at the beginning of this chapter, not only the core network is important for the farmers' agricultural decisions. In the following paragraphs the actors of the periphery will be presented in detail and their influence on the farmers' adaptive capacities discussed. In order to condense the content and to avoid repetition the actors will be grouped in the analysis where possible and sensible.

Ministry of Water and Irrigation

Water Resource Management Authority (WRMA)

Water Resource Users Associations (WRUAs)

To start with, it is worth and necessary to take a closer look at the water sector, especially since the lack of water is (one of) the main obstacle(s) for successful farming in the area. On the governmental side there is the Ministry of Water and Irrigation and the Water Resource Management Authority (WRMA), which will be combined in the further analysis since the farmers used the two institutions interchangeably when they were interviewed. Considered together, they have been mentioned 5 times in all Net-Map discussions and reach a total of 4.5 points in the question of influence on the farmers' agricultural decisions.

At the local level, the rules and regulations set by the Ministry of Water and Irrigation and the Water Resource Management Authority (WRMA) are implemented by Water Resource Users Associations (WRUAs). The latter have been mentioned 2 times in the interviews and allocated a sum of 1.6 'influence points'. At this point it is important to notice that the Ministry of Water and Irrigation as well as the Water Resource Management Authority (WRMA) and the Water Resource Users Associations (WRUAs) have only been mentioned in the context of farmers using river water. Since a lot of farmers do not live along rivers they do not use river water but solely rely on rain water. Therefore, there is hardly any influence on their farming decisions which originates from any of the three afore mentioned institutions. The farmers do get some information and advice from the Ministry of Water and Irrigation as concerns farming matters; these cover mainly the possibilities the farmers have for irrigation:

> We have the ministry of water who have taught us on how to store water, using dams. (Person 3, Transcript mo1, p.8)

> They also assisted in training farmer groups on water harvesting catchments. (Person 7, Transcript bo1, p.23)

What makes the Ministry of Water and Irrigation and the Water Resource Management Authority (WRMA) to have a great influence on the farmers' agricultural decisions is their authority over water issues:

> **Person 7:** They have great influence, if, for instance, they say you would not use water for irrigation, even if you had whichever type of crop in the farm you would not proceed to utilize that water.
>
> **Interviewer:** How has that influenced you in your farming practice?
>
> **Person 7:** I try as much as I can to avoid irrigating my land, so I am left with no options. (Transcript bo1, p.28)

> Ok, let's give them 10 [points in allocating influence on their agricultural decisions, author's note] then, because if for instance the ministry officials realize that there is no adequate water for domestic use and drinking, they may require a water intake point to be closed. (Person 2, Transcript mo1, p.25)

These three actors were perceived by the smallholders to have great enforcing power. No other actor was reported more often to enforce the farmers in their agricultural practices – mainly regarding irrigation. In different places of the Net-Map discussions the small-scale farmers stressed the influence those two institutions have by setting up rules and regulations on water use and conservation and by enforcing these rules and regulations. But they do not only see the authorities as an obstacle for free access to river water and for irrigating their crops. The farmers also value them for ensuring that the use of the river water is regulated which grants them water from the river (at least as long as there is water in the river).

> Mostly river water is consumed by large scale farmers, when the ministry follows up I am able to get some water. If they did not the river would dry up and I would not be able to do crop farming. Without them we would not be able to do anything. (Person 5, Transcript mo2, p.16)

> The ministry of water always sends officials to check whether people are using water well and ensure that everyone gets water. If one is misusing water then they enforce [proper use, author's note]. (Person 7, Transcript bo1, p.24)

The officials of the Ministry of Water and Irrigation and of the Water Resource Management Authority (WRMA) have different options of ensuring and enforcing proper use of water,

starting from confiscating water pumps, closing intakes to the point of handing the respective person(s) over to legal authorities.

The water issue is of utmost importance and an immense obstacle to the farmers. Since there are a lot of farmers who do not live near a river and who do not use the river water for irrigation but solely rely on rain water, the role of the institutions in the water sector for the farmers' social opportunity networks is twofold:

For farmers who live along the rivers joining a Water Resource Users Association (WRUA) can bring clear advantages for their farming practices. They can get connected to piped water for irrigation and they might also learn about water harvesting and water storing methods and techniques as well as about the use of greenhouses. Despite providing the smallholders with information, the main function of the three institutions is regulative. They control the water sector and even though there is quite a lot of enforcement, they also (should) guarantee the equal distribution of water among all users. This regulative function is at the same time a meditative function since the equal distribution of water reduces conflicts about water.

Farmers who do not live near a river do, for obvious reasons, not join Water Resource Users Associations (WRUAs). For them, these institutions are of minor importance in their social networks. Therefore, they hardly get in touch with the Ministry of Water and Irrigation, with the Water Resource Management Authority (WRMA) or with a Water Resource Users Association (WRUA). According to the results found here, the farmers living along rivers thus do not only have better access to the vitally important resource of water, but they also have better access to (public) organizations of the water sector where they can allocate (technical) information and advice about water catchments and water conservation methods. Farmers who do not live alongside a river are deprived of this *additional* source of information and advice on water. It can be assumed that this is also true for getting access to funding for water related issues, like constructing intakes or tanks and the like.

The Water Resource Management Authority (WRMA) and the Water Resource Users Associations (WRUAs) offer a certain amount of security in an environment of insecurity. As mentioned earlier, the insecurity of the water supply and the erratic character of the recent rain patterns make it very difficult for the smallholders to plan their cultivation cycle and to make decisions about investing into livestock. At least for the farmers living alongside the rivers a guaranteed amount of water allows them to plan and to make decisions regarding their agricultural practices. A guaranteed amount of water is decisive for agricultural adaptations in

this respect. Unless there is a drought, the management of the resource water and the (more or less) constant supply of water are regulated by the Water Resource Management Authority (WRMA) and the Water Resource Users Associations (WRUAs). Following the rules and regulations set and enforced by these institutions can promote the adaptive capacity of the small-scale farmers. Where an equitable access to the resource water is guaranteed by the WRMA and WRUAs, it has the potential to contribute to a peaceful environment, to lessen conflicts over water and thus enhance successful adaptive processes.

Where no equitable access is ensured, people might tend to ensure their access to the resource by themselves, creating a situation of mutual distrust and leading to disproportional abstraction. In turn, this may lead to a low overall agricultural efficiency through the waste of the resource by some farmers and the lack of the resource for other farmers. As a consequences this processes could substantially weaken adaptive capacity. This means that if the institutions WRMA and WRUA operate well they have the potential to contribute to a strengthening of the adaptive capacity of the smallholders.

Farmers who do not live alongside the rivers can solely rely on the rains and on their water harvesting systems and catchments. There is no institution regulating their need for water. The existence of the WRMA and the WRUAs might weaken the adaptive capacity of those farmers who do not own properties along a river. This is probably not intended but since they do not only regulate the use of the river water but also spread information about the water sector and help providing access to the resource water for *one* part of the farmers, they automatically disadvantage the other farmers. Especially since water is such a valuable and vital resource in the area it might be helpful for the smallholders' adaptive capacity if all farmers were included into developments in the water sector, even if they do not live along rivers. The hydrologic accounting of an area does not only consist of its rivers and tributaries – it is a lot bigger and more complex and the inclusion of all smallholders in developments concerning water processes could thus potentially benefit all people involved.

Government Veterinary Officer

Private Veterinary Officer

Though the Government Veterinary Officers have been mentioned 4 times, their influence on the small-scale farmers' agricultural decisions is regarded very little; they were allocated 1.1

“influence points” in sum. The reason is mainly that there are not enough Government Veterinary Officers around to care for all farmers.

> Sometimes back there used to be a veterinary officer in Umande such that if your cow for instance needed to be inseminated he would respond fast, but today there isn't, you have to go to town, all the same when the vet officer is around, he is of great use, because he provides us with medicine and artificial insemination services. We pay for these services. (Person 3, Transcript wo2, p.13)

This statement was affirmed by a government official of the Ministry of Livestock:

> **Interviewer:** […] And we're just wondering again, how many farmers does one vet officer consult or cover in an area is it in a year or whatever time that you give, the time span you give them…?
>
> **Person 1:** Now, that ratio we have not worked out yet, but we have about 500 veterinary, government veterinary officers.
>
> **Interviewer:** In Kenya or in..?
>
> **Person 1:** In Kenya, in Kenya
>
> **Interviewer:** Wow, those are very few.
>
> **Person 1:** Yeah, and you know, farmers are in the millions.
>
> **Interviewer:** Wow, those are just like a drop in an ocean.
>
> **Person 1:** A drop in an ocean, that's why we need other actors to supplement our activities.
>
> Interviewer: Aha
>
> **Person 1:** And even these 600 or 500, almost a third are in management positions, they are not exposed, so I mean they are not helping the farmers directly, do you see now ?
>
> (Expert of the Ministry of Livestock Development, Transcript Ministry of Livestock, p.8)

Another problem is that the services of the Government Veterinary Officers are not free; on the contrary they are very costly for the small-scale farmers and sometimes not affordable at all:

> If one has livestock and maybe he requires the artificial insemination services he has to go for the vet officer from town, pay for the vehicle and the fee for that day and sometimes because you're not able you may be forced not to use the vet service but instead use a bull. (Person 4, Transcript wo2, p.21)

Concerning their livestock farmers have mostly to learn how to treat it themselves:

> Most of our farmers are their own vets. They have learned to become vets from experience for example we use these leaves to treat east coast fever and a hot rod to burn the swollen lymph nodes. (Person X, Transcript control group, p.5)

The Private Veterinary Officers were mentioned 2 times and got a total of 0.6 influence points in all Net-Map discussions. The services of Private Veterinary Officers are - just like those of Private Agricultural Extension Officers - hardly affordable for the small-scale farmers.

> And currently the private veterinary officers came in. When we had the government vet officers, our problems were less because when you told them your problems, they would follow up for you. But the private vets think of money, when you have to call them and pay them. If you don't have money your livestock will just die. (Person X, Transcript control group, p.5)

Farmers groups

Women Groups

Agricultural Farmer Groups and Women Groups have been mentioned 4 times together and together they have gotten 2.5 points of influence on the farmers' agricultural decisions. Farmer and Women Groups have different advantageous functions for the smallholders' social opportunity networks. Farmers are encouraged by the government institutions to form groups because this way a lot of people can be reached at the same time and it is a lot easier to disperse agricultural information and advice to them – especially in a context where there are not enough Agricultural Extension Officers and Government Veterinary Officers.

> As a group we are able to get people who can train us. Let's give them 7, because as a group trainers also look for us and introduce new practices for example rearing new breeds of rabbit. (Person 5, Transcript mo2, p.16)

Additionally, where farmers join in groups they can circulate the information and advice they have among their fellow farmers. Farmer and Women Groups can be considered an important transfer site for news and knowledge.

> We were advised by the agricultural extension officer and we discovered that instead of staying at home it would be better if we joined up. […]It is useful because when we are in a group we learn a lot from each other. (Person 3, Transcript wo1, p.11)

The farmers are strongly encouraged to form groups for the above mentioned reasons. In turn, farmers notice how joining a group can help them during drought:

> Recently people formed groups after being informed that our MP [Member of Parliament, author's note] would provide us with dairy goats. People formed the groups, and even if I did not personally join, I have seen that they are going on well, I have seen that it is assisting, because after members have contributed, the goats were provided and this is really assisting on the side of milk provision. (Person 4, Transcript wo2, p.10)

In general, it is astonishing that the farmer groups and women groups seem to be regarded not overly important and seem to have so little influence on the farmers' decisions. Groups have a lot of potential in the light of agricultural adaptations for the small-scale farmers. The advantages of forming common interest groups become most obvious when looking at the smallholders' lack of vital resources. Most of the farmers do not have sufficient financial capital to buffer climate induced changes and shocks or to invest in new technologies and farming practices. Both measures are crucial though in order to adapt to climate variability and change. Therefore, farmers need options to allocate financial capital or to substitute it. In this context, forming groups could play a significant role. Substituting financial capital could be achieved in groups, for example, machinery syndicates could be founded or private extension services could be hired together. Farmers could organize their own field days or workshops. Furthermore, the majority of today's funds and projects are geared to already established groups. Working with groups is also for donors/ NGOs/ government institutions more effective since groups are places where information and resources can be spread directly and in a high density. Farmers who organize themselves in groups are therefore more likely to get access to different forms of financial capital as well as to information and knowledge.

Substituting financial capital by forming groups (social capital) is one of the most important possibilities the farmers have for enhancing their adaptive capacities. This is especially evident where smallholders stated that even though they have the will to undertake adaptive measures on their farms, they simply lack the financial capital to do so. In order to breed better adapted and/ or more productive livestock races the small-scale farmers would have to use the artificial insemination services of the government veterinary officers, for example. These are often not affordable for the smallholders. This means that they are refused this possibility for adaptation. The lack of financial capital and thus the missing access to livestock breeding programs clearly hinders the smallholders' adaptive capacity. The same accounts for any other agricultural innovation or innovative practice, which the smallholders cannot afford. It seems paradox that farmers are denied adaptations where they have the will and need for it. Again, groups have the advantage that they can bundle the financial assets as well as multiply and spread information or natural resources (e.g. genes). Starting a breeding program in a group can reduce the costs for input and for implementation considerably and raise the pool of knowledge as well as the likelihood of successful adaptation. In a world where time has become money, a group also helps to accelerate the breeding process, which usually takes many years for a single farmer. Results can be gained earlier and costs reduced. Finally, most small-scale farmers in the area have very

few livestock. If they invest into their livestock and a drought sets in, they are at risk of loosing not only the livestock but also their additional investment. A group could also reduce this risk by creating preventive actions and insurance mechanisms.

Syngenta Foundation

Kilimo Salama

Syngenta Foundation is added to the potentially important actors of the farmers' opportunity networks as a successful example of a cutting point between the private sector and the NGO sector. They have been mentioned 3 times out of 6 with a total influence of 1.7. The research results indicate that Syngenta Foundations seems to have a lot more potential to assist farmers. The analysis of the content of information and advice they bring to the farmers showed great potential as regards adaptive and innovative farming techniques:

> In my farm I practice two types of farming, one that relies on rain and greenhouse farming. With regard to the greenhouse I was supported by Syngenta [Foundation, author's note] to understand its importance as well as teaching me the way to make a greenhouse and they also assisted me to get the materials from Nairobi, well I paid the money but they assisted me to buy it since I would not even have known where to get it from. On putting it up they taught me how to cultivate tomatoes because it was my first attempt and it was very successful because when I compare it with other things that we have lived to do the greenhouse was the best thing. (Person 2, Transcript bo2, p.2)

Greenhouse farming with drip irrigation is a very effective way of farming in this area and it is introduced to the farmers where the financial situation allows this investment. Syngenta Foundation also promotes "Kilimo Salama". According to its own description "Kilimo Salama" ('Safe Agriculture') is an insurance designed for Kenyan farmers so they may insure their farm inputs against drought and excess rain. The project, which is a partnership between Syngenta Foundation for Sustainable Agriculture, UAP Insurance, and telecoms operator Safaricom, will offer farmers who plant on as little as one acre insurance policies to shield them from significant financial losses when drought or excess rain are expected to wreak havoc on their harvests. (cp. "Kilimo Salama" website: http://kilimosalama.wordpress.com/about/)

> **Person 2:** Syngenta [Foundation, author's note] usually invites greenhouse farmers for seminars, they always invite the agricultural extension officer from the government too. The agricultural extension officers are also given a chance to educate the farmers during such forums.
>
> **Person 3:** Even Syngenta [Foundation, author's note] has been coming to educate us by informing us the types of seeds they have and what we need to do, they would for instance tell us, that if we bought a two kilogram package of maize, you save twenty shillings and if your crops fail they will pay you such that if it is the two kg package of maize they will pay you exactly that

> and if it is one bag of fertilizer, if the crop you planted using it fails, they'll pay you back the fertilizer cost. Syngenta [Foundation, author's note] officials are usually in the radio very much, so the radio also may be giving feedback to Syngenta [Foundation, author's note].
>
> **Interviewer:** Ok, the second link we need to look at involves resources. So Syngenta [Foundation, author's note] gives you seeds...
>
> **Person 3:** Not giving, you buy but put 20 KSH for seeds and 50 KSH for fertilizer, so that if the crops fail, they will refund you so that the seeds are not lost and you'll have some to plant next time. (Transcript bo2, p.16/17)

An in-depth interview with Syngenta Foundation revealed that they have a lot more information and advice to offer and that they are very active in the region, despite only few farmers in this survey seemed to have known their work. Also, the farmers who mentioned "Kilimo Salama" did not know it is a project by Syngenta Foundation. Syngenta Foundation seems to have good national and international connections and therefore plenty of linking capacities, options where to apply for funding, where to get resources and the like. Being part of a bigger foundation, which is working around the world their capacities in assisting farmers are limited. Having an actor like Syngenta Foundation in their social opportunity networks can make a decisive difference for the smallholders' adaptive capacities. This is best illustrated by the urgent water problem. Many farmers living along the rivers have been connected with pipes and pumps to local water intakes and get a regulated amount of water through these channels. But there are still many farmers who are not connected to the local water system. Water as the limiting factor, its access is vital and has to be achieved by effective water harvesting, storage and use. The farmers need to get in touch with organizations specialized in the water sector; they need to actively use their social opportunity networks to get assistance and information about water issues. Syngenta Foundation has, on the one hand, connections in the water sector, on the other hand, they have resources for research and for finding solutions. In an in-depth interview an official of Syngenta Foundation stated that they have found at least 6 old and currently unused dams built by white settlers during colonial times. The official in charge estimated that these dams could soon be rehabilitated as they have silted up and could then provide around 4,000 households in the area with water (see Transcript Syngenta Official, pp.21f.). This example shows that even though the smallholders themselves might not have the assets to detect, to assess, to restore and to expand the old dams to become part of their water supply system, they have a vital connection to an actor, which is able to undertake the aforementioned measures. It also shows the need for more actors like Syngenta Foundation for agricultural research and training.

World Vision

Medeva

Kenya Rainwater Harvesting Project

The analysis of the sector of Non-Governmental Organizations (NGOs) yielded a surprising result. NGOs in the region did not seem to be of great importance for the agricultural practices of the small-scale farmers. The latter did neither seem to be well informed about NGOs working in the area nor about their projects. NGOs were mentioned in only 2 Net-Map discussions. Their influence has been rated low; all mentions taken together they reached a total of 1.6 "influence points" (of which the NGO World Vision got 1.2 points). All three NGOs were reported to have assisted in the water issue, providing pumps, pipes and water reserve tanks to the small-scale farmers as well as the technological knowledge for their use (cp. Transcript bo2, p.5/11/18/20 and Transcript wo2, p.9/12/18/25).

A little exception to this was the NGO World Vision, their projects have been terminated in 2009 but their interventions have been reported to still have an effect today:

> It is important because in our place now even when there is drought, people still have water. Even if not a lot I have observed that people do not completely lack food at least just little for feeding. (Person 4, Transcript wo2, p.9)

In fact, World Vision is still a potentially important actor for the smallholders in the area because they are available for the farmers in times of need and they have the means to help changing the farmers' dependence on rainwater:

> We give them 6, because with the water they have provided we are able to irrigate our land. They also responded on our call for assistance when we had problems and they came in and they were able to change my reliance on rainwater dependent crops to horticulture. (Person 3, Transcript wo2, p.21)

For enhancing their adaptive capacities, collaborating with NGOs can be a successful possibility. Especially in groups, farmer can approach NGOs to get assistance in the form of knowledge or even resources such as pumps and the like. Often criticized though is the short duration of the projects which poses a threat to the sustainability of the measures taken.

Large-scale farmers and owners of large estate

Dorep (large-scale poultry firm)

Homegrown (large-scale farm that produces and processes flowers and vegetables for export)

L. Institute (owner of large estate/ ranch)

Two more interesting actors in the farmers' social opportunity networks, which are worth a closer look, are the large-scale farmers and other owners of large estates in the area. They have different roles and functions in the network and influence the farmers' agricultural decisions in quite different ways. First of all, the large-scale farmers could provide information to the small-scale farmers to which the latter usually would not have access to. Due to better financial and technological capacities the large-scale farmers often have better access to high-quality information on for example the climatic development in the area or on new technologies etc.

> Even Mr. T. [large-scale wheat farmer, author's note] relies on the meteorological department, because since he is more financially able he may sometimes inquire how the Nanyuki weather conditions will be like even as concerns his aircraft traffic. (Person 3, Transcript mo1, p.15)

However, there is normally hardly any contact between large- and small-scale farmers. Even more remarkable in this context is an example of how the small-scale farmers still get at least indirect information on the climate from a large-scale farmer:

> **Person 3:** […] I am a neighbor to a very famous 'mzungu' wheat farmer called T. This man is so good in mastering the weather patterns, at times it will start raining but he had not planted, but sometimes he would plant, I just don't know how he chooses this. I have learnt to do what he does, for instance, planting when he plants...
>
> **Person 1:** So, this 'mzungu', I think does not rely on Kenya meteorological department officers because when we plant, our crops fail at a time when he himself had not planted.
>
> **Person 4:** I remember a time our beans failed and he had not planted [all are laughing].
>
> **Interviewer:** Do you usually ask him, or do you just observe?
>
> **Person 3:** I do not ask, but I have realized he is a farmer who would not want to suffer losses, so I have decided to do what he does and I have succeeded.
>
> **Person 1:** Initially we would plant wheat, which would dry due to drought, but every time his wheat was very ok. He would not miss on the right time to plant. (Transcript mo1, p.13)

The socio-cultural hierarchy of the inhabitants in the area obviously still does not foster contact between the smallholders and the holders of large estates. But the small-scale farmers are well aware that the large-scale farmers have easy access to information which would be valuable for themselves, too.

> We give the large-scale farmer 6, because we tend to follow his agricultural practice... When he does something I rush to do the same. (Person 3, Transcript mo1, p.24/25)

Beside this function of a role model, in case of a severe drought the owners of large estates can also have the function of a last resort which small-scale farmers can call upon before they loose their livestock:

> Another thing that we usually rely from him [an owner of large estate, author's note] especially during drought is livestock feed. For instance there was a time it was so dry and we were allowed to graze our livestock though on instructions not to carry 'pangas' or axes to prevent tree cutting. (Person 6, Transcript bo1, p.18)

> In 1992 when there was grass scarcity we had to go and look for grass from the large-scale farms, which are owned by 'wazungus'. Like in this area we have some ranchers who just keep livestock and wildlife, for example Mr. D. By the way if you go to Mr. D.'s farm he will allow you to cut grass any time. There is another 'mzungu' near the river, don't know his name, we also get grass from him. (Person X, Transcript control group, p.1)

Another possible function of large-scale farmers is offering an income alternative to the small-scale farmers if they sub-contract them as out-growers or employ them to work on their farms.

> Mostly people who have assisted us are companies, because earlier we were used to spray our crops with chemicals that would worsen the situation. When the companies started coming which included Kongoni, Home Grown, KHE (Kenya Horticultural Exporters), Everest, they would come with their seeds and teach us how to plant, bring us chemicals for spraying and we would eventually sell to them and they would cut their costs from the sale. (Person 3, Transcript wo2, p.8/9)

However this function has to be viewed critically. The large-scale farms might give the small-scale farmers work and contracts, but they are also reported to use arguable methods:

> […] The main problem we have is that when they [the small-scale farmers, author's note] are going for this contract, they don't involve us but by the end of the day, the farmers are exploited a lot. They come crying when we cannot assist. (Agricultural Extension Officer, Transcript Agricultural Extension Officer, p.14)

> Concerning Dorep, if a farmer bought from them a hen you have to buy from them medicine. They also send their own veterinary officer to treat the chicken. In case one does not abide to buy these they do not buy the chicken. (Person 1, Transcript bo1, p.24)

Also, the large-scale farmers were reported repeatedly to abstract too much water from the rivers and to pollute the water with the chemicals they use:

> Mostly river water is consumed by large scale farmers, when the ministry follows up I am able to get some water. If they did not the river would dry up and I would not be able to do crop farming. Without them we would not be able to do anything. (Person 5, Transcript mo2, p.16)

> But now if you go to the river when there are no rains, when you go upstream those large-scale farmers those settlers use all the water in the river and the water just gets finished suddenly. All the water in the rivers is directed to the dams of these large-scale farmers like Homegrown. Even now, if these rains had not come, the rivers would be dry in this season. We ourselves never control our intake, they are the ones who control our intakes. When there is no water in the rivers, there is nothing we can control, because large-scale farmers such as Homegrown have taken all the water in the rivers. They have very large dams and all the water goes to them. Now us the usual people we are the ones who suffer. That makes us realize that the government has no control over water. The government only cares where they get a lot of money, you see, corruption is the source of all these problems. (Person X, Transcript control group, p.4)

> The agricultural extension officer could also be linking with the large-scale farmers and tell them not to pollute the water by the chemicals they use in their farms, he has the authority to do that. (Person 2, Transcript wo2, p.12)

Large-scale farmers and holders of great estates in the area can obviously be of great value in the farmers' social opportunity networks as role models or alternative sources of information, as places of last resort regarding livestock feed, and as possible income alternatives. On the other hand they can also add to the small-scale farmers' burdens if they abstract too much water from the rivers than they are allowed, if they pollute the water in the rivers or if they exploit the smallholders using disputable contracts.

District Commissioner (DC)

Member of Parliament (MP)

The District Commissioner was mentioned in 2 Net-Map discussions and got a total of only 0.3 influence points:

> **Person 2:** That chief cannot influence what I practice.
>
> **Person 1:** DC […] is just like the chief. (Transcript mo2, p.14/15)

The small-scale farmers did not give explanations for the little influence of the Member of Parliament.

Ex-Web Mwireri Water Project

Muoroga Water Project

The two Water Projects were only mentioned by one farmer in one Net-Map discussion. Their influence was rated rather high for being mentioned just once, they were allocated 1 point. The reason therefore was that the respective farmers had - according to him deliberately and for no obvious reason but jealousy - been disconnected from the piped water which caused the loss of several harvests.

> We give the water projects 5, because they have the same power like the individual farmer, that is, if they decide that the farmer is not going to use the water, the farmer does not have an alternative. (Person 2, Transcript bo2, p.21)

Chemical Companies

Chemical Companies were mentioned in 1 Net-Map discussion and their influence was rated 0.6 influence points. During the interview they were used synonymously to the Agro-Veterinary Shops therefore they will not be further analyzed.

Ministry of Livestock/ National Agriculture Livestock Extension Program (NALEP)

The Ministry of Livestock was mentioned once with an overall influence of 0.6. The Ministry of Livestock was synonymously used as the Agricultural Extension Officers and will therefore not be further analyzed. The NALEP, which is a program of the Ministry of Agriculture, was seen as a donor agency but it was not mentioned further:

> As for me I have benefited a lot from the ministry of agriculture extension officers who would collaborate with a donor organization called NALEP. (Person 1, Transcript mo2, p.4)

Kilimo Biashara

"Kilimo Biashara" was mentioned once with an influence of 0.6. The farmers could not exactly identify whether it was an NGO or a Government Organization and described the information and advice they give as follows:

> They provide advice on how to undertake agricultural practices that will not lead to losses, how to use water in a profitable manner and how to use good seeds. (Person 7, Transcript bo1, p.23/24)

This is insofar interesting as “Kilimo Biashara” is a project of the Equity Bank partnering with the Alliance for a Green Revolution in Africa (AGRA), the International Fund for Agricultural Development (IFAD), the Government of Kenya and Amiran Kenya, providing a low interest loan facility for smallholders. The project could possibly be of great use for the smallholder, but it seems hardly to be known to them. It was only mentioned once and perceived as doing something very different than they actually do. The project could probably play an important role in the small-scale farmers’ opportunity network as a source of financial resources enabling better adaptive capacity, but it does not seem to be easily accessible to the farmers.

Ministry of Forestry

The Ministry of Forestry was mentioned once with an overall influence of 0.4. The Ministry was said to establish tree nurseries where the farmers can buy seedling to plant on their properties, which in the long run will help the smallholders on their farms:

> The trees are a source of livestock feed, especially during drought because we cut the tree branches to cows, goats at a time when there may not be anything else available for the livestock to feed on. (Person 3, Transcript wo2, p.23)

Other Farmers

This actor was mentioned once with a total influence of 0.1. Other Farmers were identified as fellow farmers in other regions but Umande. In the course of the discussion it became obvious that the farmers hardly ever interact or exchange information or resources etc. with the farmers from other areas. This is partly due to the great distances the farmers had to overcome if they wanted to meet and partly due to the relevance of the information since the western side of the Mount Kenya plateau has very specific climatic conditions, which are not comparable to most of the other parts of Kenya.

> They are saying they give […] the other farmers 1, because they are far and rarely interact with them. (Translation by the Interviewer, Transcript bo1, p.27)

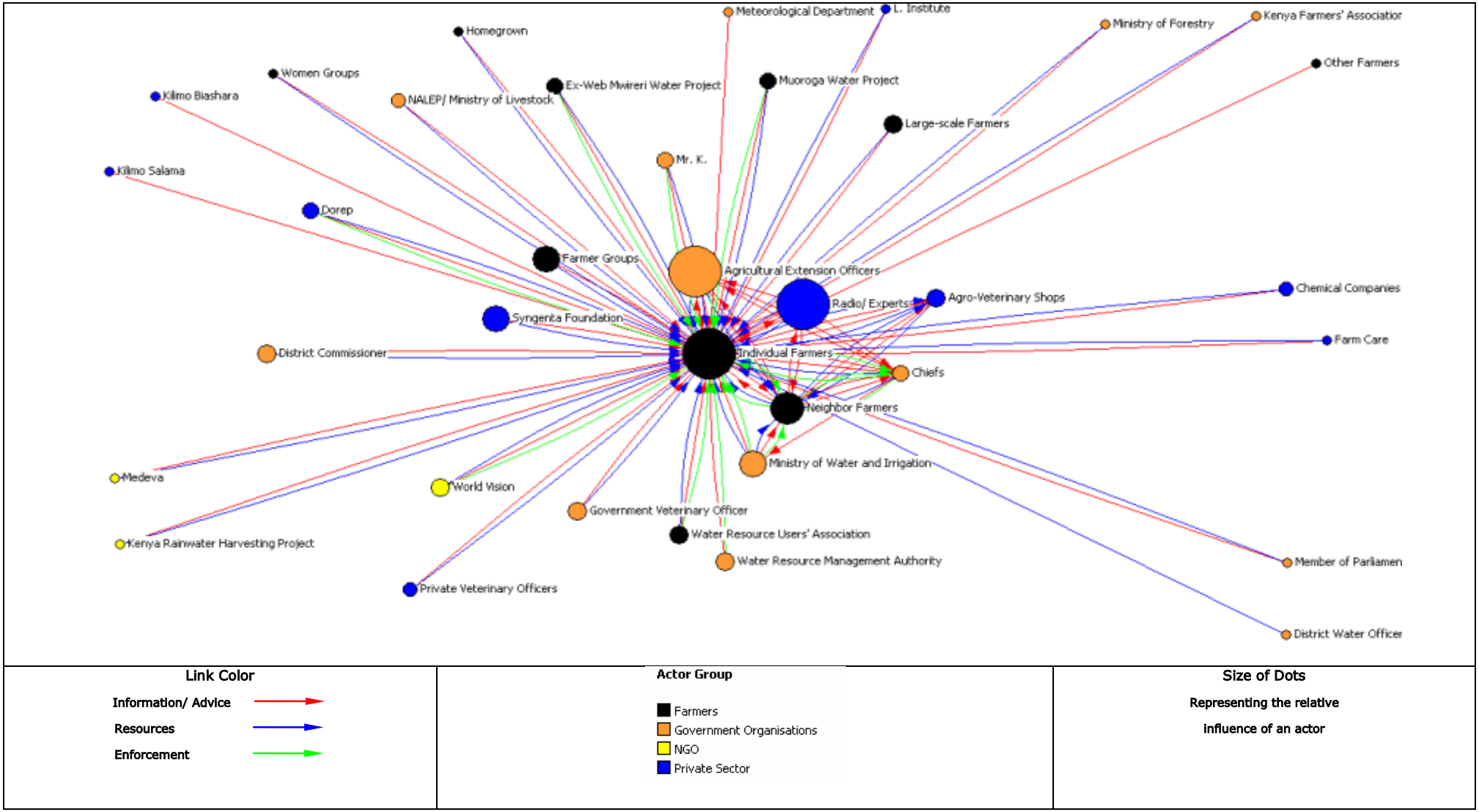
District Water Officer (DWO)

The District Water Officer was mentioned once in connection with the dispute over water, which a farmer had with a water project. Otherwise he or she was not mentioned and did not get any influence points on the smallholders’ farming decisions.

4.3 Visualization of the smallholders' social opportunity network

Finally, as indicated at the beginning of this chapter, the aggregated visualization of the small-scale agro-pastoralist's social opportunity network will be presented. The visualization shows all 36 mentioned opportunity network actors. At the center of the opportunity network the 6 core network actors can be seen, at the periphery the other 30 actors. The actors are represented by colored dots, the size of the dots are thereby resembling this actors' respective influence on the smallholders' agricultural decisions, the colors of the dots are resembling the according actor group to which the actor belongs to. The distance between the actors and the small-scale farmers resembles the frequency of their mentions in combination with their influence. Actors which were mentioned very often and which have a relatively high influence therefore appear closer to the smallholders than actors which were mentioned less often or which were less influential. Actors with the least influence and the most seldom mentions are consequently found furthest away from the small-scale farmers. The links between the actors and the smallholders are resembled by colored lines, the red lines are representing the links "information/advice", blue lines are representing the links "resources" and green lines are representing the links "enforcement". The arrow heads of the lines are representing the direction of these links, for reasons of feasibility and visual clarity the arrow heads were left out for the links of the networks periphery.

Figure 8: Visualization of smallholders' social opportunity network



Source: Figure compiled by author

5 Conclusion

The overall goal of this study was to find out how social networks and network opportunities influence the adaptive capacity of smallholders in the context of climate variability and change. As we have seen, the hypothesis that more formal network structures would lead to a higher degree of adaptive capacity did not hold true in this analysis. Rather, far more complex opportunity network structures were found like a core social opportunity network and a network periphery as well as network peculiarities like structural holes, resource and knowledge brokers, last resorts and information platforms. These network structures and the actors' roles for and functions in them seemed to influence the smallholders' capacity for adaptive agricultural processes a lot. In particular, the access to and the dissemination of information, knowledge and know-how crucial for successful adaptations in agriculture seemed to be a major problem for the local small-scale farmers. Agricultural education, information about innovations and new technologies, the knowledge where and how to get the latter from as well as the capacity to critically scrutinize all these information and knowledge would be of utmost importance for the smallholders' capacity to adapt to climate variability and change. Social networks can play a central role for providing and disseminating tacit and explicit knowledge and for bridging the lack of capital, technology and resources.

Therefore, it would be interesting to further analyze the social networks of the smallholders, especially in connection with social learning processes, knowledge transfer and innovation. Research could further generate knowledge about existing threats and about possible future threats related to climate variability and change for the smallholders. This would be important for the latter in order to anticipate future scenarios and to develop future strategies to adapt to change. Research could also play a crucial role for the farmers in learning about active, strategic and goal-oriented networking. The research tool "Net-Map" could be engaged for this purpose as it can help to understand the individual network environment, to see the network structure, to detect structural holes and to identify positions of strategic power. It can further uncover particular links, relations and goals of network actors. Consequently, strategies for future goal-oriented networking could be developed and applied by the smallholders.

Based on the results of this study, the following recommendations can be made for political decision-makers: Firstly, in order to enhance the smallholders' vital access to agricultural knowledge and information, it could be beneficial to resource the agricultural extension service provided by the government with personnel. For supporting the smallholders to sustain their

livelihood securities, more well-trained, well-equipped and committed agricultural extension officers would be needed who actually have enough time to care for the small-scale farmers' agricultural needs and challenges. Substituting agricultural extension officers with information desks as planned by the government does not seem to plug this structural hole as the predominant form of knowledge dissemination in the area seems to be on a verbal basis, not in written forms. More training programs in form of field days, excursions and common projects would be needed for the small-holders. The same accounts for government veterinary officers who also are in too small numbers compared to the small-scale farmers. In the light of adaptive capacity, breeding programs targeting farmer groups could be established. In collaboration with research institutions doing the survey and evaluation of the breeding program, farmers could be educated in the monitoring part, for example.

Secondly, government institutions could more strategically target already existing and well-working social network structures like common interest groups, the WRUAs, or the chiefs for disseminating agricultural knowledge and information. In order to prevent the exclusion of certain groups, these established structures or positions could be seen as starting points within a general plan for knowledge management in the area. In this context, water projects and programs about on-farm water management integrating farmers *who do and who do not* live along rivers should be established, especially when thinking about the conflictive dimension which the issue of the lack of water has in the area. Furthermore, the Water Resource Management Authority would be required to keep a strict controlling eye on issues like water usage and pollution by smallholders and especially by large-scale farmers.

Thirdly, more reliable information from other sources would be needed. Concerning the seasonal and short-time weather forecasts, the meteorological department might probably need more data, better equipment and well-trained staff. Concerning the agro-veterinary shops, networking, cooperation and communication with public authorities might help to ensure reliable dissemination of information.

6 References

Abukari, M./ **Schiffer**, E./ **Hauck**, J. (2009): *Influence network mapping. Mapping power asymmetry in water user groups*. In: International Fund for Agricultural Development (IFAD) [Online]. Available: http://www.ifad.org/english/water/innowat/tool/Tool_2web.pdf [Access: March 15th, 2012]

Adimo, A.O./ **Njoroge**, J.B./ **Claessens**, L./**Wamocho**, L.S. (2012): *Land use and climate change adaptation strategies in Kenya.* In: Mitigation and Adaptation Strategies for Global Change, Vol. 17, pp. 153 – 171.

Aeschbacher, J./ **Liniger**, H.-P./ **Weingartner**, R. (2005): *River Water Shortage in a Highland-Lowland System*. In: Mountain Research and Development, Vol. 25, No. 2, pp. 155 – 162.

Ashley, C./ **Carney**, D. (1999): *Sustainable Livelihoods. Lessons from Early Experience*. In: Eldis Knowledge Service of the Institute of Development, Sussex (IDS) [Online]. Available: http://www.eldis.org/go/topics/dossiers/livelihoods-connect/agriculture&id=28067&type=Document [Access: April 13th, 2012]

Bandiera, O./ **Rasul**, I. (2006): *Social Networks and Technology Adoption in Northern Mozambique*. In: The Economic Journal, Vol. 116, pp. 869 – 902.

Baumert, K.A./ **Herzog**, T./ **Pershing**, J. (2005): *Navigating the Numbers. Greenhouse Gas Data and International Climate Policy*. In: World Resources Institute (WRI) [Online]. Available: http://www.wri.org/publication/navigating-the-numbers [Access: April 19th, 2012]

Boko, M./ **Niang**, I./ **Nyong**, A./ **Vogel**, C./ **Githeko**, A./ **Medany**, M./ **Osman-Elasha**, B./ **Tabo**, R./ **Yanda**, P. (2007): *Africa.* In: **Parry**, M.L./ **Canziani**, O.F./ **Palutikof**, J.P./ **van der Linden**, P.J./ **Hanson**, C.E. (Eds.): *Climate Change 2007. Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press, pp. 433 - 467.

Bourdieu, P. (1983): *Ökonomisches Kapital, kulturelles Kapital, soziales Kapital*. In: **Kreckel**, R. (Ed.): *Soziale Ungleichheiten. Soziale Welt Sonderband 2*. Without Place: Otto Schwartz & Co., pp. 183 – 189.

Christensen, J.H./ **Hewitson**, B./ **Busuioc**, A./ **Chen**, A./ **Gao**, X./ **Held**, I./ **Jones**, R./ **Kolli**, R.K./ **Kwon**, W.-T./ **Laprise**, R./ **Magaña Rueda**, V./ **Mearns**, L./ **Menéndez**, C.G./ **Räisänen**, J./ **Rinke**, A./ **Sarr**, A./ **Whetton**, P. (2007): *Regional Climate Projections*. In: **Solomon**, S./ **Qin**, D./ **Manning**, M./ **Chen**, Z./ **Marquis**, M./ **Averyt**, K.B./ **Tignor**, M./ **Miller**, H.L. (Eds.): *Climate Change 2007. The Physical Science Basis. Contribution of Working Group I to the*

Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge/ New York: Cambridge University Press.

Coleman, J.S. (1988): *Social Capital in the Creation of Human Capital*. In: The American Journal of Sociology, Vol. 94, pp. 95 – 121.

DFID (1999): *Sustainable Livelihoods Guidance Sheets. Section 1*. In: Eldis Knowledge Service of the Institute of Development, Sussex (IDS) [Online]. Available: http://www.eldis.org/go/topics/dossiers/livelihoods-connect/tools&id=41731&type=Document [Access: April 13th, 2012]

Diaz-Bone, R. (2006): *Eine kurze Einführung in die sozialwissenschaftliche Netzwerkanalyse.* In: Mitteilungen aus dem Schwerpunktbereich Methodenlehre, Vol. 57. Berlin: Institut für Soziologie, Freie Universität Berlin. Available: http://www.unilu.ch/deu/publikationen_300859.html [Access: April 20th, 2012]

Dow, K./ **Downing**, T.E. (2006): *The Atlas of Climate Change. Mapping the world's greatest challenge*. London: Earthscan.

Eriksen, S./ **Laerss**, L.O. (2003): Cicero Report 2003:02. *Pro-Poor Climate Adaptation. Norwegian development cooperation and climate change. An assessment of issues, strategies and potential entry points* [Online]. Available: http://www.cicero.uio.no/media/2465.pdf [Access: April 20th, 2012]

FAO (2011): *The State of Food Insecurity in the World. How does international price volatility affect domestic economies and food security?* In: Food and Agriculture Organization of the United Nations (FAO*)* [Online]. Available: http://www.fao.org/publications/sofi/en/ [Access: April 13th, 2012]

Flury, M. (1988): *Small-Scale Farming and Changes of Land Use in the Highland of Laikipia, Kenya.* In: Mountain Research and Development, Vol. 8, No. 4, African Mountains and Highlands, Continued (Nov., 1988), pp. 265 - 272.

Hartwich, F./ **Monge Pérez**, M./ **Ampuero Ramos**, L./ **Soto**, J.L. (2007): *Knowledge management for agricultural innovation. Lessons from networking efforts in the Bolivian Agricultural Technology System.* In: Knowledge Management for Development Journal, Vol. 3, No. 2, pp. 21 – 37.

Hoang, L.A./ **Castella**, J.-C./ **Novosad**, P. (2006): *Social networks and information access. Implications for agricultural extension in a rice farming community in northern Vietnam.* In: Agriculture and Human Values, Vol. 23, pp. 513 – 527.

Hollstein, B. (2010): *Qualitative Methoden und Mixed-Methods-Design*. In: **Stegbauer**, C./ **Häußling**, R. (Eds.): *Handbuch Netzwerkforschung*. Wiesbaden: VS Verlag für Sozialwissenschaften, pp. 459 – 470.

Hulme, M./ **Doherty**, R./ **Ngara**, T./ **New**, M./ **Lister**, D. (2001): *African Climate Change. 1900 – 2100*. In: Climate Research, Vol. 17, pp. 145 – 168.

Hulsebosch, J./ **Marcilly**, B./ **Schaeffers**, L. (2006): *Uniting through networks. The art of fostering ICT for development (ICT4D) networks.* In: Knowledge Management for Development Journal, Vol. 2, No. 2, pp. 33 – 47.

IFAD (2011a): *Rural Poverty Report. New realities, new challenges. New opportunities for tomorrow's generation.* In: International Fund for Agricultural Development (IFAD) [Online]. Available: http://www.ifad.org/rpr2011/report/e/rpr2011.pdf [Access: April 13th, 2012]

IFAD (2011b): *Addressing climate change in East and Southern Africa*. In: International Fund for Agricultural Development (IFAD) [Online]. Available: http://www.ifad.org/operations/projects/regions/pf/pub/climate.pdf [Access: April 16th, 2012]

IPCC (2007): *Fourth Assessment Report (AR4). Climate Change 2007. Synthesis Report*. In: Intergovernmental Panel on Climate Change (IPCC) [Online]. Available: http://www.ipcc.ch [Access: March 17th, 2012]

Kiteme, B./ **Gikonyo**, J. (2002): *Preventing and Resolving Water Use Conflicts in the Mount Kenya Highland-Lowland System through Water Users' Associations*. In: Mountain Research and Development, Vol. 22, No. 4, pp. 332 – 337.

Ludwig, F./ **van Scheltinga**, C.T/ **Verhagen**, J./ **Kruijt**, B./ **van Ierland**, E./ **Dellink**, R./ **de Bruin**, Ka./ **de Bruin**, Ke./ **Kabat**, P. (2007): *Climate change impacts on Developing Countries - EU Accountability. In: European Parliament, Policy Department, Economic and Scientific Policy* [Online]. Available: http://www.europarl.europa.eu/committees/en/studiesdownload.html?languageDocument=EN&file=18331 [Access: April 18th, 2012]

Lyon, F. (2000): *Trust, Networks and Norms. The Creation of Social Capital in Agricultural Economies in Ghana.* In: World Development, Vol. 28, No. 4, pp. 663 – 682.

McNeeley, S.M. (2009): *Seasons out of Balance. Climate Change Impacts, Vulnerability, and Sustainable Adaptation in Interior Alaska.* Dissertation, University of Alaska, Fairbanks [Online]. Available: http://www.uaf.edu/files/rap/McNeeley_Dissertation_2009.pdf [Access: April 14th, 2012]

Mergel, I./ **Hennig**, M. (2010): *Lehrbücher der Netzwerkforschung*. In: **Stegbauer**, C./ **Häußling**, R. (Eds.): *Handbuch Netzwerkforschung*. Wiesbaden: VS Verlag für Sozialwissenschaften, pp. 931 – 939.

Monge, M./ **Hartwich**, F./ **Halgin**, D. (2008): *How Change Agents and Social Capital Influence the Adoption of Innovations among Small Farmers. Evidence from Social Networks in Rural Bolivia.* IFPRI Discussion Paper 00761 [Online]. Available: http://www.ifpri.org/publication/how-change-agents-and-social-capital-influence-adoption-innovations-among-small-farmers [Access: May 4th, 2012]

Moore, N./ **Alagarswamy**, G./ **Pijanowski**, B./ **Thornton**, P./ **Lofgren**, B./ **Olson**, J./ **Andresen**, J./ **Yanda**, P./ **Qi**, J. (2012): *East African food security as influenced by future climate change and land use change at local to regional scales*. In: Climatic Change, Vol. 110, pp. 823 – 844.

Morgan, W.T.W. (1962): *The 'White Highlands' of Kenya*. In: The Geographical Journal, Vol. 129, No. 2, pp. 140 - 155.

Ngigi, S.N./ **Savenije**, H.H.G./ **Gichuki**, F.N. (2007): *Land use changes and hydrological impacts related to up-scaling of rainwater harvesting and management in upper Ewaso Ng'iro river basin, Kenya.* In: Land Use Policy, Vol. 24, pp. 129 – 140.

Notter, B./ **McMillan**, L./ **Viviroli**, D./ **Weingartner**, R./ **Liniger**, H.-P. (2007): *Impacts of environmental change on water resources in the Mount Kenya region.* In: Journal of Hydrology, Vol. 343, pp. 266 – 278.

Pelling, M./ **High**, C. (2005): *Understanding Adaptation. What can social capital offer assessments of adaptive capacity?* In: Global Environmental Change, Vol. 15, pp. 308 – 319.

Pettengell, C. (2010): *Climate Change Adaptation. Enabling people living in poverty to adapt. Oxfam Research Report* [Online]. Available: http://policy-practice.oxfam.org.uk/publications/climate-change-adaptation-enabling-people-living-in-poverty-to-adapt-111978 [Access: April 20th, 2012]

Portes, A./ **Landolt**, P. (2000): *Social Capital. Promise and Pitfalls of its Role in Development*. In: Journal of Latin American Studies, Vol. 32, pp. 529 – 547.

Putnam, R./ **Leonardi**, R./ **Nanetti**, R.Y. (1993): *Making Democracy Work. Civic Traditions in Modern Italy*. Princeton, New Jersey: University Press.

Schiffer, E. (2007): *Net-Map toolbox. Influence Mapping of Social Networks. Making the most of social networks* [Online]. Available: http://netmap.files.wordpress.com/2008/04/netmap_brochure.pdf [Access: April 11th, 2012]

Schiffer, E./ **Hauck**, J. (2010): *Net-Map. Collecting Social Network Data and Facilitating Network Learning through Participatory Influence Network Mapping*. In: Field Methods, Vol. 22, No. 3, pp. 231 – 249.

UNDP (2007): *Human Development Report 2007/08. Fighting Climate Change. Solidarity in a Divided World.* In: United Nations Development Program (UNDP) [Online]. Available: http://hdr.undp.org/en/reports/global/hdr2007-8/ [Access: March 17th, 2012]

UNFCCC (2007): *Climate Change. Impacts, Vulnerabilities and Adaptation in Developing Countries.* In: United Nations Framework Convention on Climate Change (UNFCCC) [Online]. Available: http://unfccc.int/resource/docs/publications/impacts.pdf [Access: March17th, 2012]

Wiesmann, U./ **Gichuki**, F.N./ **Kiteme**, B.P./ **Liniger** H.-P. (2000): *Mitigating Conflicts over Scarce Water Resources in the Highland-Lowland System of Mount Kenya.* In: Mountain Research and Development, Vol. 20, No. 1, pp. 10 – 15.

Wiesmann, U. (1998): *Sustainable Regional Development in Rural Africa. Conceptual Framework and Case Studies from Kenya. Part II Peasant Strategies and Ecological Adaptation in the Semi-arid Laikipia District, Kenya.* African Studies 14. Berne: Geographica Bernensia.

World Bank (2011): *Climate-Smart Agriculture. Increased Productivity and Food Security, Enhanced Resilience and Reduced Carbon Emissions for Sustainable Development. Opportunities and Challenges for Converging Agenda. Country Examples.* Washington, DC: The World Bank.

7 Figures, Tables, Abbreviations & Acronyms

7.1 Figures

7.2 Tables

7.3 Abbreviations and Acronyms

DFID	Department for International Development
ENSO	El Niño/ Southern Oscillation
FAO	Food and Agriculture Organization of the United Nations
IFAD	International Fund for Agricultural Development of the United Nations
IISD	International Institute for Sustainable Development
IPCC	Intergovernmental Panel on Climate Change
LCLUC	Land Cover and Land Use Change
NAFIS	National Farmers Information Service
NGO	Non-Governmental Organization

SNA	Social Network Analysis
UNDP	United Nations Development Program
UNFCCC	United Nations Framework Convention on Climate Change
WRMA	Water Resource Management Authority
WRI	World Resources Institute
WRUA	Water Resource Users Association

8 Annex

Interview Guideline for Semi-Structured Interviews

(Agricultural Extension Officer)

- Introduction.

- Assuring interview partner that the information acquired during the interview will be used for scientific purposes only and that they will be treated utmost confidentially. For citing the interview partner, the latter we will be made anonymous, i.e. the interview partner will not be cited by name but by function.

- Seeking permission for recording.

Context: Where and how do the small-scale farmers get information and advice about agricultural practices especially when they are facing water shortages .Who do they ask for information, where do they get resources, which are the challenges they face?

Central Question 1	
We would like to know more about the information and advice you exchange with the small-scale farmers regarding their agricultural practices especially in years of drought. Could you tell use something about that?	
Aspects of Content and Inquiry	
a) What kind of information/ advice do you share with them? b) How do you pass on information to the farmers? c) What other sources of information (institutions/ organizations/ people) do you think could be valuable for the farmers regarding the use of water and agriculture esp. in years of drought?	

Central Question 2	
We would also like to know more about your role in providing resources to the small-scale farmers for their agricultural practices especially in years of drought…	
Aspects of Content and Inquiry	
a) What kinds of resources do you provide to the small-scale farmers? (Do the farmers pay for these resources?) b) How do you pass on these resources to the small-scale farmers? c) In terms of resources what other institutions/ organizations/ people do you think could be valuable for the farmers regarding the use of water and agriculture, esp. in years of drought?	

Central Question 3	
Is there a set of rules and regulations regarding your engagement with the farmers?	
Aspects of Content and Inquiry	
a) If so, what are these? b) How do you ensure that the farmers do not break these rules and regulations? c) If not, how do you ensure that the small-scale farmers follow the advice you give them?	

Central Question 4	
Are there any other structural support measures apart from the agricultural assistance which you provide to the local small-holders?	
Aspects of Content and Inquiry	

Central Question 5	
In what ways do you think these measures (probe on the earlier mentioned) contribute to reducing the vulnerability of the small-scale farmers to extreme weather conditions like droughts?	
Aspects of Content and Inquiry	
a) How do these contributions get to the farmers? b) At which costs? c) Who is being reached? d) Is there anyone or any group that are left out?	

9 Abstracts

9.1 Abstract (English)

In the context of climate variability and change the capacity to adapt to a changing environment is of great importance for the rural poor especially when they are directly dependent on agriculture and on natural resources. Social networks as a form of social capital can help enhancing adaptive capacity but they can as well erode it. This case study of small-scale agro-pastoralists in a semi-arid region in Laikipia District, Kenya, contributes to the understanding of the influence which social networks and social network opportunities have on smallholders' capacities to adapt to climate variability and change. Using the empirical research tool 'Net-Map', both qualitative and quantitative information about the small-scale farmers' social networks and social networks opportunities were collected. The data were subsequently analyzed combining qualitative methods of social network analysis with descriptive statistics. The results indicate that the farmers generally use a 'core' social opportunity network, which is constituted of actors perceived as most important for their agricultural decisions. The networks also consist of a network 'periphery', of varying actors which are perceived less important. Further, the social opportunity networks of the smallholders expose structural holes at crucial positions which hinder the dissemination of essential agricultural knowledge. Other found features of the social opportunity networks like resource and knowledge brokers, like last resorts and like information brokerage platform have the capacity to foster smallholder adaptive capability. Very much depends on the actors and the way they are engaged in the social opportunity networks as the discussion of the results reveals.

9.2 Zusammenfassung (Deutsch)

Vor dem Hintergrund der Phänomene Klimawandel und Klimavariabilität wird die Fähigkeit sich an eine sich wandelnde Umwelt anzupassen gerade für die armen Bevölkerungsschichten im ländlichen Bereich eminent wichtig. Die erwarteten Auswirkungen des Klimawandels werden dabei als zusätzliche Herausforderung gesehen, da vor allem die Ärmsten weder die finanziellen, noch die sozialen oder technologischen Kapazitäten zur Anpassung haben und dazu meist direkt von Landwirtschaft und von natürlichen Ressourcen abhängig sind. Soziale Netwerke werden oftmals als Ressource der Armen, als Ultima Ratio beschrieben, wenn keine anderen Formen von Kapital verfügbar sind. Soziale Netzwerke als eine Form des Sozialkapitals können helfen, die

Anpassungsfähigkeit von armen Bevölkerungsgruppen zu verbessern, sie können diese aber auch zusätzlich schwächen. Die vorliegende Fallstudie untersucht den Einfluss von sozialen Netzwerken und Netzwerkmöglichkeiten auf die Anpassungsfähigkeit von Kleinbäuerinnen und -bauern an Phänomene des Klimawandels in einer semi-ariden Region in Kenia. Dazu wurden qualitative und quantitative Daten über die sozialen Netzwerke und Netzwerkmöglichkeiten der Agro-pastoralistInnen gesammelt und ausgewertet. Zur empirischen Datenerhebung wurde das Forschungsinstrument „Net-Map“ eingesetzt, zur Auswertung der Daten wurden qualitative Methoden der sozialen Netzwerkanalyse mit Methoden der beschreibenden Statistik kombiniert. Die Ergebnisse zeigen zum einen, dass die KleinbäuerInnen generell eine Art Kernnetzwerk benutzen welches aus Akteuren besteht, die sie für ihre landwirtschaftlichen Entscheidung als am wichtigsten betrachten. Die Netzwerke bestehen weiters aus einer Netzwerkperipherie, die sich aus variierenden und weniger wichtigen Akteuren zusammensetzt. Zum anderen wurden in den sozialen Netzwerken und Netzwerkmöglichkeiten strukturelle Löcher gefunden, die sich an entscheidenden Stellen befinden und die die Verbreitung von essentiellem Wissen behindern. Andere gefundene Eigenschaften der Netzwerke wie Ressourcen- und Wissenshändler, Akteure die als letzte Hilfsmöglichkeiten dienen oder Informationshandelsplattformen haben die Fähigkeit, die Anpassungskapazität der Kleinbauern zu verbessern. Ob diese Fähigkeit tatsächlich genutzt wird, bestimmen zum großen Teil die Akteure und die Art, wie sich diese in sozialen Netzwerke und Netzwerkmöglichkeiten einbringen.

10 Curriculum Vitae

Personal information

Date and place of birth: July 19th, 1983 in Kempten/ Allgäu, Germany

E-mail address: agnes.zehrer@gmail.com

Education

03/2006 until present	**University of Vienna**, Austria:
	International Development
	Main focus: Integrated Mountain Development
10/2005 – 02/2006	**Leopold-Franzens-Universität Innsbruck**, Austria:
	Translation Studies (English, Spanish, Russian)
09/1993 – 06/2002	**Gymnasium Marktoberdorf**, Germany

Language skills

Mother tongue:	**German**
Other languages:	**English** (fluent)
	Spanish (good)
	Russian (basics)

Internships and practical experiences

* Field research for diploma thesis in Nanyuki, Kenya (07/2011 – 09/ 2011)

* Participation in excursion on "structural change and regional development in the region of Himachal Pradesh, India" (Institute of Geography of the University of Vienna, 09/2010)

* Internship at the Children's Villages "Pater Alfred J. Spiessberger" in Santa Cruz und San José de Chiquitos, Bolivia (01/2005 – 05/2005)