NUI MAYNOOTH
Ollscoil na hÉireann Má Nuad

A dynamic assessment of adaptive capacity to climate change: A case study of water management in Makondo, Uganda

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ABSTRACT

This thesis is carried out against the backdrop of serious concerns that climate change will affect the livelihoods of rural people in Sub-Saharan Africa. I examine the adaptive capacity of people at the micro-scale of action and practice in rural Africa, in particular those in Makondo Parish, in the southwest of Uganda. The focus is on the way adaptive capacity emerges from the interaction of community members, extra-local actors such as non-governmental organizations, and national and local policy-makers. The thesis builds upon literature that explores adaptive capacity at the micro-scale of action and practice in rural Africa. The research, which employs context-sensitive methods, specifically ethnographic and participatory methodologies, contributes to a growing literature on adaptive capacity to climate change in three key ways.

First, methodologically, I argue that the application of participatory Geographical Information Systems (PGIS) alongside ethnography can offer a context-sensitive approach for assessing the complex subject of adaptive capacity. The approach – which I refer to as a 'dynamic assessment of adaptive capacity' – can reveal data about people and their places that might not otherwise emerge; data that may be of critical importance to understanding adaptive capacities. The approach helps uncover complex realities in relation to both social connections and connections with place.

Second, the thesis explores adaptive capacity and water governance. The results of the research reveal that relations and practices may affect the adaptive capacity of people in these areas to

deal with climate change. Although at the household level people display context-based adaptive strategies such as water recycling and seasonal adjustments, the overall adaptive capacity of community members is constrained by gender-based and village-level water governance mechanisms that limit how future adaptive strategies will develop. My dynamic assessment of adaptive capacity takes these complex issues into consideration with a view to developing an understanding of how adaptive capacity is shaped by access to resources and power. My study therefore suggests that, at the micro-scale, adaptive capacity strategies require efforts that address multiple limitations with regards water governance, because these limitations may be associated with the various determinants of adaptive capacity.

The third contribution concerns the role of agro-pastoralism in shaping adaptive capacity. Results from the research reveal that adaptive capacity is happening via a complex web of relationships that have implications at individual level. Agro-pastoralists display context-based adaptive strategies such as application of local knowledge about water, cooperation and sharing and seasonal diversification of livelihoods. All these coping mechanisms benefit wider community in Makondo. However, the overall adaptive capacity of agro-pastoralists is constrained by enclosure that limits how future adaptive capacity will develop.

DEDICATION

Dedicated to my dear children, Uchizi, Ungweru, and Urunji, my wife, Ulemu, and my mother, Melise.

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Finally, I thank my family for their spiritual support and LOVE!

CHAPTER ONE

INTRODUCTION

1.1 Overview of the research

This dissertation, based on research conducted in rural Uganda between February and August 2011, explores adaptive capacity to climate change in rural Africa. Increasing and intensifying climate variability has become a major concern of scientists, as reflected in the work of the United Nations Intergovernmental Panel on Climate Change (1990; 1995; 2007). Places and people in the developing world look set to be severely exposed to such climate variability. We therefore need to know about whether and to what extent people might be able to adapt to climate change. We know that extreme climate events, such as the La Niňa drought of 1999-2000 and the floods events of El Niňo in 1997-1998, cause disruption in livelihoods in developed and developing countries (and that the latter are often worst hit) (IPCC, 2007; Kundzewicz et al., 2008) but we also need to learn about how people might cope with more gradual climatic changes. Such gradual changes certainly matter, as persistent deficits in rainfall in Eastern Africa have demonstrated. These deficits have had serious impacts on livelihoods, resulting from continued reductions in water quality, severe water shortages, increased conflicts over water resources, and the drying up of some rivers and small reservoirs, in Burundi, Ethiopia, Kenya and Uganda (UNEP, 2002). In addition, water scarcity has contributed to human mortality, and loss of livestock from hunger, thirst and disease in East Africa (UNEP, 2002). These issues highlight the additional importance of examining the adaptive capacity to climate change in the area of water management. The purpose of this dissertation research is to bring into focus this range of issues via analysis of adaptive capacity in one locale.

My more specific aim in this dissertation is to contribute to current understanding of adaptive capacity to climate change as regards water resources management by exploring:

- How individuals adapt their water management practices across all livelihoods uses and needs, including water for drinking and domestic chores
- Social dynamics with regards how communities communicate and share experiences in water management across various uses, water sources, and multiple stressors on their livelihoods
- How individuals and communities connect with extra-local actors to ameliorate their well-being in the face of climate change
- How individuals and communities learn to adapt and transform their actions with regards to enclosure and policies. That is to say, how they learn to adapt with enclosure and converging and conflicting policy interests between development and climate change adaptation on the ground.

I argue that adaptive capacity is shaped by practice on-the-ground in specific contexts but also relations with extra-local actors and their knowledge about adaptation. This interface is characterized by inequalities to adapt, since not all individuals, households and communities are equally privileged to draw on determinants of adaptive capacity. I build on literature that argues adaptive capacity involves what individuals *do* and what extra-local actors *can do* (Adger and Kelly, 1999; Pelling, 1999; Jones et al., 2010; Pelling, 2011). I aim to examine the adaptive capacity of people as they respond to seasonal climatic variations but also the actions of extra-local actors. The dissertation aims to show how adaptive capacity is shaped by the impacts of climate variability but also how reforms in governance regimes or state-led modernization efforts shape how adaptive capacity emerges.

The dissertation seeks to deepen what we know about adaptive capacity in rural Africa. A problem in the literature is that analyses of adaptive capacity have downplayed or ignored the role of perceptions, experiences, and dynamic practices in local settings that shape adaptive capacity to climate change (West et al., 2008). This dissertation also seeks to move beyond studies that privilege quantitative over qualitative analyses (Carter et al., 2007), by examining the scope that might exist to use a richer mixed methods approach. Several approaches and tools, including Geographical Information System have been used to study climate change impacts and adaptive capacity to enable effective adaptation planning and adaptive strategies planning (O'Brien et al., 2004; Füssel and Klein, 2006; Sietchiping, 2006). However, this literature has tended to focus on the modelling capabilities of GIS techniques to develop an adaptive capacity index to climate change, rather than using GIS in a participatory manner that can focus on practices in the daily lives of actors within vulnerable communities. I argue that understanding practices on-the-ground must transcend conventional applications of GIS that focus, for example, on arriving at an engineering solution of adaptation and neglecting the indirect impacts that emerge after such a solution is sought. Understanding adaptive capacity at individual, household level or macro-scale is a daunting task that must go beyond conventional approaches. This research gap demands the employment of a dynamic methodological framework that is context-sensitive. Adaptive capacity might be difficult to capture by conventional GIS approaches but participatory techniques have greater scope for success. This is because participatory GIS approaches place a greater emphasis on having community members produce and analyse data. Consequently, this dissertation seeks to combine participatory geographical information system (PGIS) and ethnography (Cope and Elwood, 2009; Elwood, 2010) to study adaptive capacity at the micro-scale. The dissertation's methodological approach therefore attempts to take into account the totality of

primary and secondary impacts of climate change when characterizing the adaptive capacity of individuals and community.

1.2 A brief description of the study area

This PhD is part of the Water is Life (WIL) project. WIL is a research project with eight PhD position attainable in Republic of Ireland. The field work for this dissertation was conducted in Makondo Parish, in Lwengo District in the southwest of Uganda (see Figure 1.1). Makondo Parish was chosen for all of the research projects with a view to pairing up with The Medical Missionaries of Mary (MMMs) which has a base in Makondo. The design of the project is to work with and benefit local partners in Uganda, therefore, my work had to focus on Makondo even though there are other areas in Uganda that are perhaps more vulnerable to climate change and experience more challenging moments with regards to water governance, such as the semi-arid region of Uganda locally known as 'cattle corridor'. Although I did not choose the study area, the WIL project allowed researchers to select villages within Makondo Parish in which they would focus their efforts. I selected two villages, Michunda and Kiganjo which I have described in detail in Chapter Three.

The landscape in Makondo has typical savannah characteristics: shrubs interspaced with grasses. Most of the gentler hill slopes and flat land is cultivated and settled; grass, trees, and some papyrus grow in the valley wetlands. The parish has several hummocks dissected by streams, rivers and swamps, including Katonga and Kanana rivers, which drain into Lake Victoria to the east. Seasonal surface runoff from rainfall is the major recharge, although most streams are dry for much of the year (GoU, 2008).

Makondo Parish is situated between the savannah tropical climate and the semi-arid climate, temperatures ranging from 26°C - 29°C with two wet seasons, the longer rains from March to May and the shorter rains between September and mid-December (Hepworth and Goulden, 2008). The parish receives average rainfall of between 750 to 1000mm. The dry period covers January-February and June to August. The June-August period is the most critical for water governance at household and community level. Though there are many social and economic challenges facing this part of Uganda, climate change models suggest that the region will begin to experience longer dry periods and more erratic rainfall, including intense and destructive downpours (NEMA, 2010). Climate change is the most significant emerging threat since 1960s: by 1990, Uganda's glaciers on the Rwenzori Mountains had receded to about 40% of their 1955 recorded cover (McSweeny et al. 2010). Extreme weather conditions have increased including droughts and over 4 million people have been affected. Rainfall declined since 1960, a rate of decrease of 3.5% per decade and the country's annual temperature has increased by 1.3°C, with a significant rise in the number of hot days and nights which are likely to have serious implications for water resources in the country (Osmaston, 1998; McSweeny et al. 2010). Boko et al. (2007) show that the water level in Lake Victoria has fallen between 2000 and 2006 due to climate change related threats. Further, Uganda has experienced 7 droughts between 1991 and 2000, and more recently the 2004/2005 severe drought has been linked to climate change. These sorts of events are predicted to increase in frequency and intensity in future (NEMA, 2010), with significant impacts on the welfare of Uganda's population (NEMA, 2010).

Communities in southwest Uganda have recently experienced some weather extremes, notably in 1999/2000 and 2004/2005, which were (the worst in memory) associated with

severe crops losses, drying up of water sources, and the loss of human lives and livestock (Hepworth and Goulden, 2008). During my time in Makondo Parish I experienced how Makondo's population is vulnerable and their position may worsen in the future if climate change does indeed make rainfall more erratic, less reliable, or if dry periods become longer as forecasted by NEMA (2007) and McSweeney et al. (2010). During my fieldwork the study communities described the longer rainy season as a good start to the rains but later it was characterised with erratic rainfalls in the second month (April) and a dry spell during the third month (May) when crops such as maize and groundnuts were almost reaching permanent wilting point (Plate 1.1). Regarding water supply, the impact of the events are felt through a reduction in the water supply in near homestead open wells which forced people to scoop or dig their open wells deeper (Plate 1.2). This scene was common across the Parish. The question is whether they can adapt their practices to cope with climate change.

Plate 1:1: Wilting maize crop in Michunda 16 May, 2011

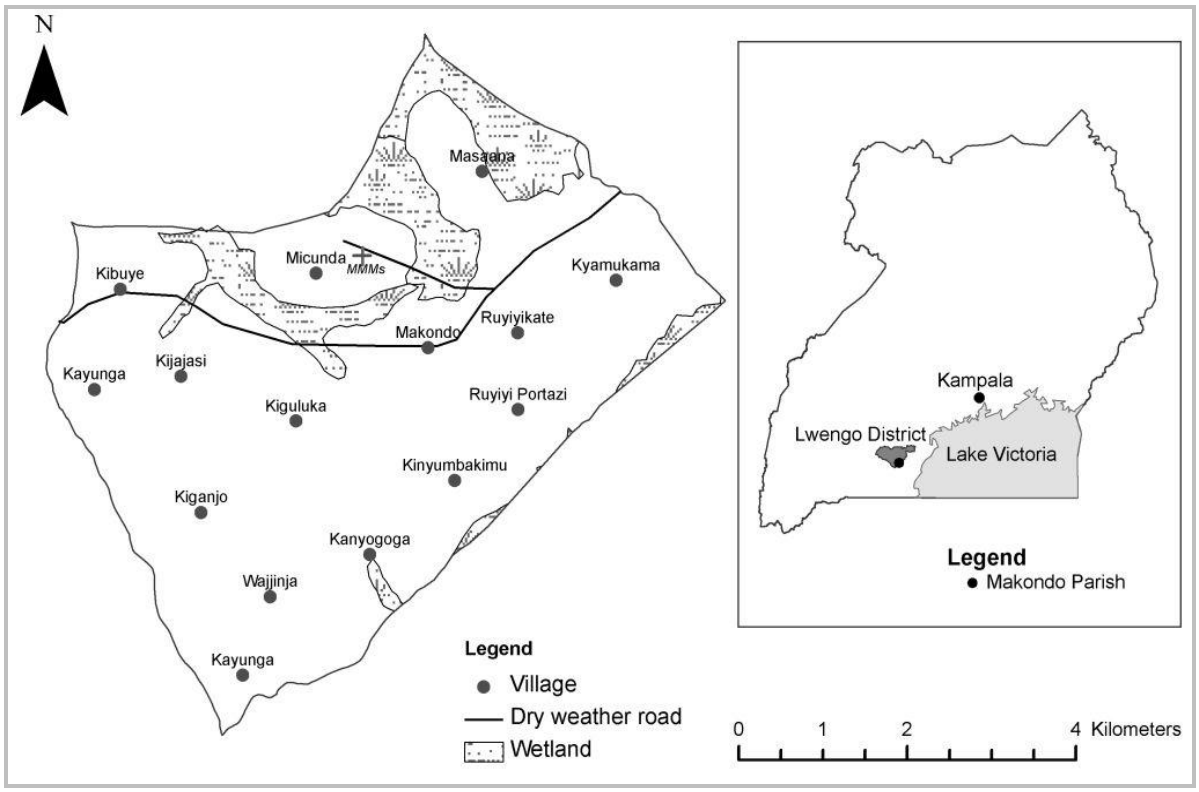
Plate 1:2: Open well management during dry season in Kiganjo, 10 July, 2011

Just over 8,000 people, about half of them aged 15 or under (UBOS, 2002), live in the Parish. The main livelihood strategy for households is based on subsistence agriculture and some cash crop agriculture on plots of approximately one acre, but some households also keep livestock. Major crops grown include sweet potatoes, bananas, beans, maize, groundnuts, sorghum and finger millet. Banana and millet are the staple foods. In recent years, coffee has grown in significance as a cash crop following improved world and local coffee prices. Few people have waged employment but there is a vibrant market area with some shops and other businesses and the parish has reasonably good connections via buses and taxis to Kampala or Masaka, the nearest large town.

Water and its frequent scarcity is a major issue of concern in Makondo. The distances households in Makondo must travel to access water sources range from a few metres to

greater than 1.5 kilometres (GoU, 2008). The most dependable but unsafe water sources are located in the valleys but they also run dry during the dry season. Government, non-governmental organizations (NGO), and the private sector have all taken steps to improve access to safe drinking water throughout Makondo Parish (GoU, 2007). Some NGOs have drilled shallow wells and improved springs. They have also supported rainwater harvesting and have provided some training in effective water governance (MMM, 2010). Local and national government engages in similar activities to the NGOs, but they also seek to enforce water sector policies concerning rural water governance. These outcomes of water governance are designed to protect the people from further vulnerability due to water scarcity (GoU, 2007) but as I discuss later, they also generate problems and dilemmas that affect adaptive capacity to cope with climate change.

Figure 1. 1: Makondo Parish in Lwengo District, Uganda



1.3 Research strategy

This study was conducted between February and September 2011. I defined my approach as a 'dynamic assessment' of adaptive capacity. I consider my approach as dynamic because it contextualized approach of assesses adaptive capacity using a wider range of methods than most studies to-date that include temporal dimension (covered both dry season and wet season), intra-household and extra-household adaptive capacity, and multi-scale water governance regimes. I pursued a context-sensitive approach using PGIS combined with ethnographic techniques. The approach drew upon an active learning-based approach. But my approach was also dynamic because it sought to understand local water governance in the context of a broader geography of adaptive capacity. As such, my research has aimed to understand how local knowledge and practices regarding water management relate and integrate with extra-local knowledge and practice. My research strategy was carried out in three stages, although in practice these three stages overlapped in complex ways.

The first stage was the formative and exploratory stage. It lasted four weeks and employed a combination of PGIS and ethnography. My objectives of this stage were to build up a general understanding of how people in the parish lived and what they understood about climate change. I tried to develop a rapport with individuals, groups and communities so that they could collaborate in my research. I then identified two villages in which to base my research: Michunda and Kiganjo. They were purposively selected on the basis of their past experience of drought, and their different relationships and connections with extra-local actors. Michunda village has modern infrastructures such as a health centre, schools, electricity and there are NGO offices present there. Kiganjo has very little infrastructure and extra-local actors have only left a legacy of one borehole and a shallow well. Although the two villages

share the same climate variations, they tend to respond differently when contingencies strike because of differences in connections they are able to draw upon. Further description of Makondo Parish is given in Chapters Four, Five and Six.

In the second stage, lasting five months, I began the work of eliciting information that would allow me to understand adaptive capacity in the two study places. I employed a mix of tools to gather data, including GPS-assisted participatory village resource mapping, participant observation, participatory tools such as meetings and workshops, transect walks and participatory diagramming. Along with village elders and volunteers, I selected community co-investigators who were trained to use the hand-held GPS units and digital cameras. Throughout this period, I recorded interviews with people in the village about how they dealt with their water resources and how they adapted to various changes in the climate as the parish moved from the wet to the dry and then back into the wet season. These interviews formed a major part of the study. I held regular meetings with research participants in small and in large groups to discuss emerging findings. Furthermore, I conducted interviews and employed participatory GIS techniques with a group of agro-pastoralists in the Parish. This was with a view to understanding how they cope with climate variations and water governance. By the end of the second period I had collaboratively constructed a rich set of insights about adaptive capacity in the study area.

In the third and final stage of the research, I worked with the villagers to create a forum in which they could communicate knowledge about their adaptive capacity to decision-makers from local government and other actors, particularly NGOs. The general question I asked was, ‘How can PGIS help to make local knowledge relevant and usable to other actors for

water management and decision-making amidst climate change?' This complex and difficult stage brought together all research groups from the communities in a workshop in which community members, including many of those lacking literacy, could speak and listen to councillors, planners, and other officials with decision-making powers. At the end of the forum I conducted open-ended and semi-structured interviews with workshop participants with a view to understanding the potential continuing benefit of my research to the participants. An account of the community meeting is given in Chapter Four.

After fieldwork ended in September 2011, I conducted iterative analysis of the data. I examined interview transcripts, notes from group discussions, and GIS layers produced with the communities, as well as additional research outputs from scholars interested in similar issues in rural Africa. I have sought to expand upon how my dynamic assessment of adaptive capacity can produce a rich understanding of how rural communities in Africa might cope with climate change.

1.4 Plan of the dissertation

Chapter Two of the dissertation explains the concept of adaptive capacity in general terms and specifically in climate change debates. It traces the origin of the concept of adaptive capacity in evolution ecology. My thesis is that adaptive capacity is a complex concept and it may not be understood or assessed using one theoretical frame: rather it needs a dynamic understanding and assessment approach which has prompted me to focus on social-ecological systems, entitlements, political ecology and sustainable livelihoods theories to explain what adaptive capacity is and how we may assess it. I also discuss how adaptive capacity has evolved in the area of climate change research and how it is assessed, specifically in Africa.

My enquiry then turns to consider issues to do with governance, especially of water resources, because the politics of water is so central to adaptive capacity, particularly at the micro-scale.

Chapter Three discusses methodological gaps in Sub-Saharan Africa regarding assessment of adaptive capacity. In this chapter I am concerned about over reliance of extensive surveys by many scholars and lesser deployment of context-based methodologies, specifically ethnography. I review some of the ways PGIS has been used in different contexts in Africa. I then propose that context-sensitive methodologies can be used to assess adaptive capacity in places like rural Africa. I argue that PGIS combined with ethnography rather than only surveys is one potential approach.

Chapter Four presents materials from my dynamic assessment of adaptive capacity to climate change in Kiganjo village. In this Chapter, I argue that PGIS presents numerous possibilities to learn about and understand communities dependent on natural resources, especially regarding their domestic water. This chapter outlines how PGIS, combined with ethnographic methodologies, can facilitate learning more about adaptive capacity and aid vulnerable communities in communicating their knowledge of adapting to climate variability to extra-local actors. It also discusses dilemmas that were encountered and explains how PGIS helped the communities to access once seemingly unattainable resources.

Chapter Five uses a case study of two villages, Makondo and Kiganjo. This chapter builds upon literature that explores adaptive capacity at the micro-scale of action and practice in rural Africa. It also extends the value of context-sensitive methods. I highlight key relations and practices that affect the adaptive capacity of people in these areas to cope with climate

change. The chapter demonstrates that context-based coping strategies such as water recycling and seasonal adjustments practiced at household level may be insufficient for future adaptation because of intra-household gender-related factors and village-level governance differences. This chapter suggests that strategies to improve adaptive capacity at the micro-scale require efforts that address limitations of water governance practices at household and village levels.

Chapter Six draws upon a case study of agro-pastoralists in Makondo. There are two contextual issues framing this chapter. The first is adaptive capacities that agro-pastoralists draw upon and their benefits to wider community in Makondo Parish. The second is about constraints that bar adaptive capacities of agro-pastoralists at the micro-scale. I specifically focus on enclosure by exploring how it interacts with the local adaptive capacity process. I argue that agro-pastoralists' adaptive capacities are severely constrained by changes in land use, including permanent and temporary forms of enclosure. These changes make the dry season much harder for agro-pastoralists. These changes are increasing adaptive capacity inequalities between agro-pastoralists and others in the Parish. My research suggests that context-based coping mechanisms such as seasonal adjustment and conflict management, are steadily eroding. The chapter concludes by suggesting that agro-pastoralists are negative about their future prospects.

Chapter Seven concludes my thesis by outlining my achievements, and noting the shortfalls and limitations, particularly regarding the methodological and conceptual understandings of climate change at the micro-scale issues that I was unable to address during my fieldwork and in the dissertation. I follow this discussion of research shortfalls with an integrated

understanding of adaptive capacity at the micro-scale. The Chapter ends with some recommendations with regards future direction of adaptive capacity assessment in rural Africa based on this dissertation.

In summary, this dissertation seeks to contribute to the literature a sense of the complexity of conceptualizing and characterizing adaptive capacity within rural communities in Africa. This objective is achieved in each of the main Chapters. Adaptive capacity in the Parish does exist but it is often at odds with extra-local actors and their actions. There are conflicts between agro-pastoralists and wider community adaptive strategies and these tensions complicate local adaptive actions. But within households, there are also complications. Intra-household dynamics concerning water governance, for example, as well as local governance mechanisms can hinder adaptive capacity, as well as promote it. The challenge for researchers is to try to understand the conditions that give rise to successful adaptive capacity. This dissertation aims to demonstrate the significance of context-sensitive approaches in understanding these dynamics of adaptive capacity.

CHAPTER TWO

THEORIZING ADAPTIVE CAPACITY

2.1 Introduction

In the previous Chapter, I briefly discussed the roadmap of this thesis and introduced the concept of adaptive capacity. In this chapter, I explore the concept of adaptive capacity in more detail and pose two questions that are discussed in the remainder of the dissertation. I start by tracing adaptive capacity as a concept generally and specifically with regards to climate change globally and in Africa. The Chapter demonstrates conceptual variations and characterization from local to global. I conclude by asking my specific research questions that form the focus of this dissertation.

Adaptive capacity is a complex concept. It can be traced from evolutionary ecology and has been theorised in work on social-ecological systems and socio-economic and sustainable development frames. It cannot be understood or assessed using only one theoretical frame: I consulted a wide range of literature that discusses vulnerability, adaptive capacity, adaptation and coping capacity. Literature on risk and the disaster reduction was among the literature that I comprehensively reviewed especially the work by Wisner et al. (2004) and resilience by Holling and Gunderson (2002). Regarding literature on risk and disaster reduction, I found it less dynamic in explaining adaptive capacity because it does not adequately address the human dimension i.e. it is model based which places much emphasis on environmental, engineering or ecological vulnerability and resilience but undermines social-political factors that shape vulnerability, resilience and adaptive capacity. My decision is in agreement with

Folke (2006), who argues that understanding adaptive capacity needs broader interpretation. While this Chapter has extensively drawn upon literature on resilience, I selectively choose to engage with authors that discuss resilience as synonymous to adaptability or adaptive capacity because core resilient theorists advance knowledge that thinks about endogenous capacity of system to cope with contingencies. I find resilience thinking static in light of my 'dynamic' approach because my dynamic thinking considers both endogenous and exogenous adaptive capacities.

Based on the foregoing argument, I will focus my discussion on social-ecological systems (SES), entitlements, political ecology and sustainable livelihoods to explain what adaptive capacity is and how we may assess it. This chapter outlines how each of these theories contributes to an understanding of adaptive capacity. In addition I discuss the concept of adaptive capacity as used and assessed within the contemporary debate on climate change; how adaptive capacity has evolved in climate change and is assessed at local and global levels, specifically in Africa. I argue that adaptive capacity is still in its infancy, that it has multiple conceptualizations and that it is frequently nebulous and hard to measure. My enquiry leads me to consider governance, because governance permeates all frames, particularly at the micro-scale.

2.2 Evolution of adaptive capacity

Adaptive capacity can be traced from the evolutionary biology contribution of Theodosius Dobzhansky (1956). He argued that man has not been adaptive as a result of biological heredity alone; rather man has the ability to learn from the environment and to modify his behavioural and external environment in order to ensure survival in a constantly

disequilibrious environment. The concept ‘adaptive’ draws upon the principle of natural selection in evolutionary theory. It focuses on adaptive traits synonymous with adaptiness and fitness, as means of becoming better adapted. Reeve and Sherman (1993) identify problems with focusing on adaptive traits alone in order to understand adaptation because it is ‘conservative’, ‘primitive’ (p. 8). This bias, towards the superiority of genetic material on human exogenous characteristics, has influenced most biological assessments with regards to use of quantitative methodologies. Building on previous research, (Dobzhansky, 1968) described adaptive traits as adaptability, which is permissive because it includes the external environment that may be favourable for the perpetuation of human population.

By adaptability Dobzhansky generally meant the quality of being adaptable, the ability to be adapted or the characteristics of an organism to be modified and to modify a range of environmental uncertainties in order to retain life and to reproduce. Novelty, diversity, adaptive behaviour and management support these characteristics, as does the ability to create highly organised societies. Dobzhansky argues that although organisms display adaptability within the ecology they occupy, their properties remain dependent on the nature of genetic material that made the change, rather than on the external environment that triggered the change. Although the external environment was recognized as an integral part of fitness, it was only considered if the adaptive trait was known to spread through natural selection – this was described as ‘nonhistorical definitions’ (Frisancho and Baker, 1970). Subsequent work inserted human behaviour into the discussion of adaptive capacity such as sociobiologists and anthropologists. Regarding the former, Frisancho and Baker (1970) show that human bodies are adaptable to many kinds of stresses, including changes in the living environment. For example, people living at high altitude develop fitness of the chest to survive lower oxygen

pressure than those at low altitude. Initial and immediate adaptive responses on arrival at high altitude include resource-based adaptation to oxygen supply, temperature and diet in order to continue to live and work.

Cultural adjustment is also central to adaptability for individuals occupying a new place alongside geographical and physiological adjustments (Weiss and Mann, 1990). These adjustments to stresses are multifaceted and occur in multiple stages, hence fitness increases with time. Initial reactive responses by individuals to contingencies are inefficient because they do not yield as high fitness as the secondary responses developed after some time of learning and experimenting in a new place. Secondary responses developed later involve cultural adaptation to life contingencies through subsistence activities, which interact with geographic and economic factors (Frisancho and Baker, 1970). Secondary responses are survival strategies, which have passed through rigorous process of observations. These include observations of variations and their source, innovation and selection from innovation, and either transform or partially transform means of livelihoods in the face of environmental change at different scales from micro to global levels (Denevan, 1983; Bodley, 2012). This multifaceted adaptation is demonstrated in the case of these living at high altitude (Frisancho and Baker, 1970). Although highlanders have developed physiologically as an adaptive response, pregnant Quechuas women experienced high rates of miscarriage when compared to those living in the lowland. Consequently, the Quechua made extra adjustments to ensure successful gestation in order to maintain population; families in these areas had differentiated capacity, exemplified in the rich highlanders sending their pregnant women to lower elevation to ensure successful gestation. This adjustment is not biologically mediated but rather it is a culturally mediated adaptive response (Weiss and Mann, 1990). Some people

and communities may adapt with geographical changes, while others may fail and die if they do not return to a place of stability (Gunderson and Holling, 2002). Therefore, genetic fitness may not guarantee high adaptability because the human system is a main contributing factor.

Contemporary literature has reinforced the significance of human systems in understanding adaptive capacity. Anthropologists and cultural ecologists discuss human adaptability as the flexibility with which individuals and communities or populations adapt to environmental changes (Regin and Lewin, 2000; Campbell and Sayer, 2003; Bodley, 2012) Adaptability is the processes by which individuals or social systems learn, alter and improve means of subsistence when faced with perturbation and add this new means to their cultural repertoire (Matutinovic, 2002; Ayres, 2008; Bodley, 2012). Factors that stimulate adaptive behaviour in human systems, and which are beyond biophysical environment, include population growth, market forces and socio-political factors. Through the process of adaptation, individuals and societies select proven and adaptable cultural practices in changing time and space, which have enabled the survival of human populations in hostile conditions e.g. the Eskimos' adaptive strategies in the north pole are not applicable for the Bushmen of Kalahari Desert (Weiss and Mann, 1990). There is consensus, therefore, that what is adaptable in one place and time may not be suitable in another place and time (Bodley, 2012). For example, ecological anthropologists observed inequalities regarding adaptive capacity and speculated on the many social causes of differential capacities such as poverty and lack of education. Although poverty and lack of education are often labelled as the root of the problem regarding adoption of innovation, scholars observed that there are many social limitations hindering successful adaptation which are as a result of local and static existing understanding (Gross and Underwood, 1971). Gross and Underwood also observed that an

understanding of disparities between the rich and the poor was important in understanding adaptation. They draw on the example of Brazil in the 1970s where it was learnt that commercialization of sisal production occurred at the expense of the labourers, whose wages were inadequate to meet the subsistence needs of their families (Gross and Underwood, 1971: 737). Households could not produce food crops and beef because of the concentration on sisal production, which was exported to North America and Europe. Exported sisal was part of the livestock production system in North America and Europe since it was used to bind animal fodder with grain feed. The fodder supported production of beef and milk, which helped to improve nutrition in this part of the world while the producers in Brazil, at micro-level, remained malnourished.

In recognizing the socio-political relations of society, anthropologists have engaged in debates in social, political, and economic spheres about the extent to which remote micro-scale spaces interact and have expression at macro-scales. For example, Wolf (1972) and Bodley (2012) argue that at micro-scale individuals and groups have rules that govern allocation of resources and associated rights and responsibilities among a given population, but local rules are often shaped by the changing interests of non-local elites or policies at national, regional and global scale. One of the challenges to human adaptation is to understand the scale of the problem since most environmental perception is local rather than global, but all are interlinked in a complex web and all influence each other. In the Brazilian example, developed nations imported sisal at extremely low prices, enforced, to a significant degree by political pressure they brought to bear on the producer country, Brazil (Gross and Underwood, 1971). It is clear that human activities have become inter-connected globally, with one decision in one region shaping adaptive capacity elsewhere. Patterns of production,

consumption and well-being depend not only on economic and social relations within a locality but also depend on other decisions in other places and their capacity to sustain local individuals (Folke et al., 1997; Holling, 2001; Allison and Hobbs, 2004).

The complexity of the situation therefore reinforces the need for a coherent framework for understanding adaptive capacity. Interpreting capacities as gradual and incremental, disregarding these connections was a major research question. Researchers such as Holling and Gunderson (2002) were concerned with partial ways of explaining adaptive capacities in interconnected social-ecological systems. Holling (1973) had observed that it was not right to measure the biophysical environment quantitatively when it is profoundly influenced by human activities that use the ecology for economic, political, cultural and conservation values. In this case, he argued that when each system, including a human system, is strongly influenced by variations external to it, and continually confronted by the unexpected, the constancy of its behaviour becomes less important that the persistence of relationship.

2.2.1 Social-ecological system (SES) conceptualization of adaptive capacity

C.S. Holling's work has been overwhelmingly related to the current understanding of adaptive capacity within the coupled social-ecological system (SES). Holling separated concepts of *stability* and *resilience* in an effort to explain and measure resilience (i.e. adaptability) in coupled systems of panarchical connections. The panarchy in human systems emphasizes 'revolt' and 'remember' concepts as central for sustaining adaptive capability. Holling's work demonstrated how resilience can be maintained in nested, iterative relationships, in dynamic hierarchies, over space and time (Holling, 1973). Regarding stability and resilience, Holling and Gunderson (2002: 18) argue that the original

conceptualization by Holling represented a narrow view of a fixed and static notion of human system to local perturbation. Holling and Gunderson (2002) insert a dynamic notion into stability and resilience. These concepts are described as significant characteristics and capabilities that have made it possible for people to not only persist passively, but also to create and innovate when limits are reached in face of contingencies. Gunderson (2000) considers stability and resilience as concepts that are not entirely separable, and refers to both terms as resilience.

The terms resilience and adaptive capacity are also sometimes used interchangeably (Walker et al., 2004).The term resilience has multiple meanings: the capacity of the system to absorb disturbance without changing its stability (Gunderson and Holling, 2002); a system's capacity to absorb and reorganise while undergoing change so as to still retain essentially the same function, structure, identity and feedbacks (Walker et al. (2004); a coping capacity or response capacity (Turner et al., 2003); an ability to generate a different kind of learning from abrupt change, transformative learning and self-organising (Holling and Gunderson, 2002). Despite the variations in definition it is through resilience that adaptive capacity is gained by individual actors operating at different social and ecological scales in multi-actor environment. Generally, resilience has become a developing research arena for understanding integrative research in adaptive capacity, one of the most significant challenges facing global change (e.g. Folke, 2006). Thus, the concept 'adaptive capacity' has evolved from narrow interpretations in engineering to broader understanding in ecosystem resilience, social resilience to SES, and governance (Folke, 2006).

The expanded interpretation of adaptability broadens the application of SES in the analysis of adaptive capacity, into the wider spatial and temporal scales of the political economy because of its focus on systems' transformability, learning and innovation and on an integrated system feedback. This takes place in dynamic interactions across-scales but within each level operating at its own pace (Folke et al., 2005; Folke, 2006). Walker et al. (2004) refer to adaptive capacity as the capacity of people in SES to build knowledge, incentives, and learning capability into institutions and organisations for governance procedures that support adaptive management across scales i.e. local, regional and global. Some of the characteristics of multi-level adaptive capacity are collaboration, flexible institutions, and social networks in multi-level governance (Folke, 2006). This involves individual or collective responses to internal and external perturbations or improvement to existing conditions even if there could be no major change in the external environment.

Regarding panarchical connections and the two concepts of 'revolt' and 'remember', Holling (1973: 1) also contributed to the initial debates on measuring the resilience of nested systems. Holling and Gunderson (2002) posit that the world is always in disequilibrium with multiple connections between levels and between phases at levels. Revolt and remember are two significant connections for sustainability especially at times of change in adaptive cycle. The 'revolt' in panarchy represents micro-level creative capacity experience collapse; that collapse can cascade up from fast and small events at micro-scale to the next larger and slower level and so on. Cascade effects can cause a critical transformation in an organisation policy and behaviour: for example, in New Brunswick a small group of people that was opposed to spraying insecticide over the forest succeeded in transforming regional forest management policies and practices because they had become broadly vulnerable.

'Remember' is a cross-scale interaction important in times of change, renewal and organisation. In the same example in New Brunswick, the group drew upon potential that has been accumulated and stored in the form of (local) knowledge and forest management practice (Holling and Gunderson, 2002: 75-76). Memory provides context and a source for renewal, recombination, innovation, novelty and self-reorganization following disturbance during remember (Folke, 2006). Holling argued against the tendency of emphasizing theoretical and empirical ecology that inevitably inherited quantitative methods from classical physics. Rather he argued that attention be paid to qualitative methods because of their ability to document observed characteristics of resilience. Holling proposed that humans are not only able to live and reproduce; they can also exploit the biophysical system for social, economic and quality of life gains. Folke et al. (2005), drawing on Holling's work, has developed an adaptive capacity framework to accommodate this shift of perspective in SES that is inclusive, descriptive, and does not require a precise prediction of the future but instead supports qualitative capacity assessment. Folke's contribution includes the human dimension which represents a departure from mainstream assessment of adaptive capacity which excluded human dimensions e.g. *model-based* assessment did not adequately capture the human system, political, social or economics dynamics across multi-scale interactions (Folke 2006).

Folke's adaptive capacity framework considers actors as bonding agents for adaptive capacity in multi-level interactions because they provide a source of resilience, while governance is responsible for the delivery of the resources needed for adaptive capacity i.e. the determinants of adaptive capacity. Determinants help local communities to gain access through networks to extra-local actors and their resources such as technical assistance,

financial resources, knowledge and technologies. Because these networks can spread across national and international boundaries, locals on their own might find it hard to connect without the assistance of an intermediary. It might also be hard for locals to adapt by themselves. The framework shows that at the micro-scale, learning is by practice; through practice, local people become more adaptable to contextual issues. Although contextual learning is messy and non-hierarchical in structure, learning and reorganisation are faster at the micro-scale than they are at meso- and macro-scales (Gunderson and Holling, 2002; Folke, 2006). The differences in pace may represent difference in agency to respond to particular perturbation in the environment by individuals and external actors such as State and non-governmental organisation (NGO). The slower and intermediate speed can be critical regarding supporting renewal, innovation and self-organisation because they occur at meso and macro scales and thus are well structured and have the ability to store large amounts of knowledge e.g central and local governments and United Nations. This knowledge in turn can be employed to support micro-scale adaptive capacity.

However, Folke (2005) argues that extra-local actors may also cause barriers, tension, and an erosion of adaptive capacity when cultural dynamics, created by policies, impose values, neglect the local problem by addressing a world view of the problem, or create competing interests. Ecologists have been criticised for their tendency to insufficiently address the realities of human behaviour such as organisational structures and institutional arrangements that mediate the relationships between people and nature (Holling et al. 2002). Studies have shown that highly centralised governance regimes can impede renewal and learning. Palh-Wostl (2007; 2009) has argued that a governance system may not be fully understood if it is decoupled from the environment, and material and non-material resources or entitlements.

Folke (2006) notes that efforts at understanding coupled systems are still in an exploratory stage and there is an opportunity for creative approaches and perspectives. Indeed, the current approach has insufficiently addressed issues regarding access to stored stocks of the tangible and intangible during 'remember' connections. Not all adapting individuals may access entitlements of stocks because of the social-political relations embedded in mediating structures (e.g. Sen, 1981).

2.2.2 Entitlement and political ecology conceptualization of adaptive capacity

The entitlement theoretical understanding of adaptive capacity tends to focus on access to resources. In *Poverty and Famines: An Essay on Entitlement and Deprivation* Amartya Sen (1981) discusses vulnerability and coping capacity (i.e. adaptive capacity) side-by-side. The entitlement of an individual represents a set of different alternatives, 'commodity bundles', which an individual can acquire through the use of various legal channels of procurement available in a particular context. In a private ownership market economy, the individual's commodity bundle and the procurement of alternative commodity bundles are determined by *original endowment*; for example, a pastoralist may survive by selling cattle in order to buy cheaper calories such as maize (Sen, 1981:105). Adaptive capacity therefore depends on original endowment because this is the springboard for coping strategies. The determinants of endowments include: macro- and micro-economics; employment; class in society; policy environment; and information and external connections with aid agencies. These determinants, Sen posits, are constrained by the forces behind them; they can enhance capacity in one context and constrain it in another or both can happen simultaneously in one place. Sen argues that we cannot adequately understand vulnerability or adaptive capacity without critically looking at both ownership patterns and exchange of the entitlements and the

forces that lie behind them. This requires careful consideration regarding the nature of modes of production and the structures of economic class as well as their relationships (Sen, 1981: 6).

Given that adaptive capacity is the flipside of vulnerability, it can be described as how individuals, households, and extra-local institutions experiencing disturbances employ opportunities in a given context that help them to cope with vulnerability. Sen's (1981) entitlement theory challenges the premise of famine (an example of vulnerability), suggesting that it is not primarily caused by changes in biophysical events such as droughts, floods and pests. This has been demonstrated by two great famines in the world (e.g. Ethiopian famines of 1973 and 1974, and the Bengal famine 1943) where there was starvation and death of people even though there was no significant decline in food availability. In these circumstances the adaptive capacity of the poor did not only depend on their abilities to respond to these hazards (Sen, 1981). Rather three factors impacted on access to food: Poor policies, for example, first, the government's overriding concern with national or aggregate food availability statistics, rather than individual access and utilization of food; second, market dynamics, especially when the business merchants hold commodities (services) in anticipation of future profitability (Kirzner, 1978; Cummings, 2002; Tiwari, 2007); third, poor transport infrastructure. In addition, at the micro-scale, choice as a characteristic can have a significant impact on adaptive capacity; this may include people refusing to eat unfamiliar food. These challenges suggest that, when mapping capacity to cope with perturbation, there is a need to go beyond traditional thinking in terms of *what exists,* to a consideration of *who commands what* and *how is it invested or utilised* (Sen, 1981: 8). In other words, the adaptive capacity of an individual or group of individuals is determined by

their ability to compete for resource endowments including those made available by extra-local actors.

The entitlement approach therefore proposes a shift from considering how people cope with changes in the biophysical environment alone to focusing on an individual's capacity to access entitlements, an individual's own production, labour and market exchange and social security relief. The focus therefore is on governance of endowments because governance has a direct influence on the way the poor can access and utilize endowments and consequently how people can shape their adaptive capacity. Regarding entitlement thinking, adaptive capacity results from *access* to resources and assets through legal means and markets that represent the *springboard* from which adaptive actions can be made after undertaking judicious decisions about how best resources can be accessed and utilized by the individual. The entitlement approach provides a general perspective that can be used in assessing adaptive capacity generally as well as adaptation to climate change. This approach is sensitive to contextual issues such as forms of endowment and the role of markets: for example, Bengal in South Asia and Ethiopia in Africa had different endowments, namely employed labour and pastoral livelihoods respectively (Sen, 1981). These two places had different coping strategies.

The entitlement approach has some shortcomings, particularly where it focuses so much on accession of entitlements. Scholars have critiqued the approach in a number of areas, for instance, its limitations with regards ambiguities in entitlement specification and extra-legal entitlement transfers (Devereux, 2001). Methodological insufficiency in the approach has also been observed, specifically because the approach has tended to overemphasize economic

aspects above social-political determinants of adaptive capacity (Osmani, 1991). By emphasising access to resources and assets, other aspects of political ecology are neglected, for example, policies that fight against vulnerability; one group can suffer exactly from another group's consolidated adaptive capacity because of entrenched structural forces that work on processes mediating resources needed for individuals' well-being (e.g. Blaikie, 2001) .

Political ecology understands adaptive capacity as closely tied to external forces entrenched in societal relations, especially power at different scales, which enhance or restrict adaptive response. Although political ecology acknowledges the significance of governance institutions and interrelationships in mediating entitlements and providing enabling environment for adaptation, these never occur in neutral space (Blaikie, 1987). Piers Blaikie's work shows that it is often not possible for policy interpretation and application to occur in a neutral institutional setting when addressing economic resources, especially at the local level (Blaikie, 1987). Political ecology views environmental issues and capabilities to adapt as politicised and suggests that they cannot be examined in isolation from the political and broader economic context within which differential capacities are produced (Escobar, 1998; Crifasi, 2009).

The political ecology literature demonstrates how the adaptive capacity of local communities is shaped or constrained by political, governance and economic processes at wider geographical scales. This premise explains how entitlements are always embedded in macro-level institutions provided by political economy. Many authors have made contributions to understanding vulnerability from this perspective (Blaikie, 1987; Blaikie and Brookfield,

1987; Blaikie, 1995; Escobar, 1998; Pelling, 1999; Zimmerer and Bassett, 2003; Rocheleau, 2008; Watts, 2008). The stance of political ecologists is that differential access to resource endowments occurs at different scales. The underlying access principle embraces both tangible and intangible endowments (entitlements) needed for livelihoods by the poor: generally these include land, labour, water, knowledge and information, and financial capital. Most policy reforms make an explicit assumption that planned strategies lead to a more efficient use of resources and consequently greater adaptability than one might expect of traditional strategies. Traditional strategies can offer less efficient use of resources and contribute to livelihood vulnerabilities. For example, modernization of cattle keeping, especially land titling, makes the explicit assumption that it leads to more efficient use of land and high profitability, consequently higher adaptive capacity than nomadism, which is usually viewed as less efficient economically and ecologically (Heald, 1999; Nyariki et al., 2009). However, viewed through the political ecology lens, both questions are about extremes of modernization and nomadism. On the one hand, modernization cannot be effectively attained without significant public and institutional infrastructures to support deployment of adaptive strategies; in fact, this can lead to enclosing commons by elite classes and business conglomerates (Akram-Lodhi, 2007; 2008; 2010), which in turn can lead to inequalities regarding access to resources (Butler and Gates, 2012).

The literature shows that the establishment of entitlement will often be biased to the extent that one group's adaptive capacity frequently benefits at the expense of another's. This is significant regarding adaptive capacity on the ground. Witsenburg and Adano (2009) demonstrate that during dry months or drought, access to water was traditionally successfully negotiated to meet the needs for livestock and domestic requirements. However,

modernization in cattle keeping works to change traditional capacities through land property rights and demarcation boundaries which may even result in the construction of physical barriers – with the creation of boundaries it is increasingly hard to maintain traditional arrangements of water sharing (Witsenburg and Adano, 2007; 2009).

Regarding domestic water needs, water access usually refers to the proportion of the population that is using improved water sources such as boreholes, and it takes into consideration quantity, quality, spatial and distance. WHO and UNICEF (2012) access refers to the use of 20 litres per person per day from an improved water source that is less than one kilometre away from home. An update on progress on drinking water indicates that the world has met its goal of bringing drinking water to millions of the world's poorest people because of a demand driven, community-based approach or a neo-liberal approach that allow private sector participation in rural water supply. However, viewed through a political ecology lens, this claim is contested because many rural poor encounter challenges when trying to access water. Jones (2011) argues that NGOs are created to promote 'participation' as a community-based model in order to encourage sustainability of access through the functionality of boreholes. Jones contends that extra-local actors tend to focus more on promoting paying for water i.e. 'participation as payment' which appears to be the critical obstacle to sustainable water access. This implies that water is not equally accessible in rural settings (Jones, 2011). The focus on payment has led to an estimated 30-40% of boreholes and shallow wells not working at all or working at far below optimal levels in Sub-Sahara (Taylor, 2009; RWSN, 2010). While scholars agree on technical challenges affecting rural water supply, political ecologists attribute the low success in improved water provision to unequal power relationships resulting in pressure from NGOs and donors aimed at imposing their

perspectives and values on local communities in order to achieve a preconceived agenda. In addition, structural relations e.g. the interdependency between donor-NGO and NGO-NGO (national & local) for financial survival puts local NGOs under considerable pressure to prioritize functional accountabilities over downward accountability which has tended to compromise local participation (McNamara and Morse, 2004; Bryant, 2005; Dixon and McGregor, 2011).

The concept of power has been associated with class and it operates at various scales: at the individual through to the household on to global and these occur in a nested manner. Class and power relations are gained through the political and economic positions one holds within a community and may be viewed as the capacity entrenched in social relations through which endowments can be accessed. This may result in differential empowerment. The concept of power is still contested (see, Ward, 1978 and Hyde-Price, 2006). Power is relational and structural dominance cannot be separated from connections. In addition, every resource on which individual or collective power is based (e.g. borehole, land and water) is subject to multiple structural limitations (such as gender, wealth) and opportunities (Crow and Sultana, 2002). Power differentials influence priorities for public investment and collective decision making with regards water. Crow and Sultana argue that water for irrigation is better represented and more knowledgeably discussed in societal and scientific forums at all levels than domestic water uses identified with women (drinking, cooking and laundry), especially in low-income communities and rural settings (Cow and Sultana, 2002: 712-713). Budds (2004) argue that water, when it becomes highly politicized, becomes a resource for elite classes such as large farmers, who control water through various different means. A 'veiled nexus' exists based on connections with local politicians and government officials through

which processes within neutral laws and policies can be manipulated or by-passed (Budds, 2004: 334). Large farmers use their political and economical influence and connections to government bodies and private sectors responsible for land and water, to exploit the poor. These power relations may have far-reaching consequences at the micro-scale because they represent a double deprivation to the poor, which requires examination of the intra-household and the extra-household bargaining process, specifically with regards vulnerable groups (women, young and old) because of their low social status and limited access to needed resources (Agarwal, 2000; Blaikie, 2001). Unequal distribution of developmental benefits, particularly where this is influenced by gender, points to a critical issue in political ecology: scale.

Scale in political ecology is a very significant factor in analysing adaptive capacity to various contingencies, including environmental vulnerabilities (Blaikie, 1995; Zimmerer and Bassett, 2003). Scale is socially and politically constructed and so interactions between scales can create socio-political conditions that make certain groups more adaptable and others less adaptable or vulnerable. Macro-scale studies through national or global scale analysis may help to characterise adaptive capacity and factors that shape the capacity and remove offsets. For example, the great famines discussed by Sen (1981) show how food shortages cease to be simply a consequence of drought or environment when they are examined as part of social and political relations. Zimmerer and Bassett (2003) note that environmental problems and responses are dynamic: they found ‘hidden political ecologies’ at the micro-scale that concealed some ‘truth’ regarding land rights after the poor were engaged in mapping their resources and vulnerabilities. Without employing a political ecology lens the rural poor would have been classified as lacking capacity due to poverty and lack of education. These

cases demonstrate variability of adaptive capacity over space and time at local level and its complexity due to its connectedness to national and global processes.

Although all entitlements exist in a vulnerable context of political, economic, social and environmental changes, those empowered may best adapt. In this way, political economic debates have contributed to the conceptual understanding of adaptive capacity. However, other scholars have criticised the political ecology approach for its tendency to overemphasize politics, economics, institutions and history and downplay the biophysical (ecology) factor e.g. Chambers, 1989 and Scoones (1998). Chambers challenges the stereotype of the poor as powerless by examining the capacities that help them cope with contingencies. The opposite of vulnerability, adaptive capacity or livelihood security, stands out as a recurrent concern of poor people that tends to be overlooked in debates in political ecology. In addition, political ecology pays significant attention to the external elements of risks, shocks, and stress to which an individual or household is subject rather the internal ones against which people may be frequently defenselessness, meaning they lack the means to cope without incurring loss. As a result political ecology is a powerful tool to explain the external side of adaptive capacity of individuals or households, but wholly inadequate at explaining individual or intra-household adaptive capacity. In the political ecology approach, the capacities of the poor are simplified and distorted. In reality, as Chambers (1989) notes, the poor are not just naive victims; poor rural people have an impressive range of means that they use for subsistence, to maintain their livelihoods, and to cope with contingencies.

2.2.3 Sustainable livelihood framing of adaptive capacity

The main focus of sustainable livelihoods is on making a living or continuing to make a living in a changing environment. Its research focus is generally on exploring people's responses and enforced changes amidst vulnerabilities which tend to cut across the theoretical frameworks discussed under the genesis of adaptability i.e. SES, political ecology and entitlement frameworks. The most widely accepted definition of livelihood stems from the work of Robert Chambers and Gordon Conway: 'a livelihood comprises the capabilities, assets (including access to both material and social resources) and activities required for a means of living' (Carney 1998:4). The underlying principle of livelihood generally deals with people, their resources (e.g. land, labour, water, knowledge, access to networks) and what they *do* with them. All the resources exist in a vulnerable context of political, economical, social and climate change (Carney, 1998; Scoones, 2009). Therefore, we can consider a livelihood as having adaptive capacity when it can cope with and recover from stresses and shocks, and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base (Chambers and Conway, 1992).

Looking at adaptive capacity from an entitlement perspective, it is based on the classification of endowments that are trade-based, production-based, own-labour, and social claims. A livelihood perspective considers that households have portfolios of investments, stores and claims which change over seasons and longer periods, and have strategies for using them to deal with different stresses, shocks and demands (Chambers 1989; Scoones 1998; Scoones 2009). From this perspective, adaptive capacity of poor households is characterized as the ability to perceive pending bad times and change their ways of using resources e.g. change in diet and eating less, reflecting in part the priority they give to preserving those assets which

provide their means of livelihood (Corbett, 1988). The adaptability of rural poor individuals is made possible by developing and maintaining wider adaptive options and through the ability and willingness of different household members to do different things in different places at different times. These adaptive actions include: cultivation of a wide range of crops; herding large and small stock; labouring in agriculture or other off-farm economic activities; mortgaging and selling assets, including future labour; begging, theft; mutual support networks; and dispersal and migration of families (Chambers and Conway, 1992). Individuals can invest in personal capacities through formal and informal education and training to enhance their capabilities. They can also invest in physical resources such as land and water sources. The research demonstrates the ability of humans to store or reserve some resources to cope with contingencies such as food reserves, cash savings and livestock. The SES literature has shown how humans have adapted via interdependencies in nested relationships –social capital –that can extend from individual to global scales. The premise of the livelihood approach is to acknowledge that vulnerable contexts impoverish in different ways but individuals and households have different strategies to adapt, frequently by drawing upon their assets-base in different combinations and sequences (Scoones, 2009).

Livelihood is at the heart of all scholarship that contributes to the present understanding of adaptive capacity in developing countries, including those in Africa. Research on livelihood strategies shows that some of the strategies for adapting with contingencies at household level include sequences of adaptive strategies which are context-sensitive and are expected to vary in their combinations. Intra-household adaptive strategies with food scarcity during famine include extra austerity measures such as sequencing their adaptive strategies to match risk levels. e.g. during famine, in northern Ethiopia in 1974, poor households were found

practicing sequencing of adaptive strategies: *stage one*, reduction in quantity and quality of food eaten; *stage two*, temporary emigration by adult males to seek employment, *stage three*, sale of assets e.g. cattle or goats; and *stage four* migration of entire households in search of relief (Corbett 1988: 1104). These adjustments reflect adaptive strategies on the one hand, and the priority individuals or households give to assets that provide their crucial means of livelihoods on the other.

The livelihood approach has also been criticized, principally for its narrow focus. Many authors, for example, De Haan and Zoomers (2005) and Scoones (2009), argue that sustainable livelihoods is actor-oriented and mostly interested in the *micro-world* of lived experience, networks, and community, and seems to ignore that households are located in structures of cultural meaning and differential power. It is through changing structures, mediating processes, institutions, and organizations that appear in all livelihood frameworks that assets are mediated across-scales (De Haan and Zoomers, 2005). The tendency within the livelihoods approach is to downplay these structural and power relations and emphasize the capitals and activities that can undermine our understanding of adaptive capacity. In addition, the framework has little or no guidance regarding how to undertake assessment or which methods and tools are useful at micro-scale (Toner, 2003).

In this section the various frameworks used to examine adaptive capacity have been explored. In the consideration of this range of frameworks the adequacies in each approach are noted. The need for an integrated way of understanding adaptive capacity exists as no current framework addresses this issue to date. The following section of this Chapter discusses adaptive capacity as conceptualized in climate change literature.

2.3 Adaptive capacity: an evolving concept in research on climate change

The concept of adaptive capacity first appeared in the climate change debate in the 1980s but it was tangentially addressed. The main focus of nearly all debates and discussions around climate change then revolved around adaptation because of the interest in assessment of impact and vulnerability, and the economic implications of response options (IPCC, 1990; Tobey, 1992; Leary, 1999). In the 1990s adaptive capacity with regard to climate change was characterised in a variety of ways which essentially meant the same thing: adaptability, adaptive response, adaptive action, and adaptive behaviour (IPCC, 1990; Smithers and Smit, 1997). At this point adaptive capacity was characterized as being based on the concept of stability, resilience, and adaptability (see sub-sections 2.2.1). The literature shows that the concept was being used to refer to the ability to prepare for environmental hazards and to draw on opportunities in advance, in order to respond or cope with the effects of contingencies. Environment or ecosystem adaptability received more attention because scholars believed that it was solely responsible for the supply of services needed for human survival; it supported the livelihood of poor populations through sustainable and secure food production and wider economic development benefits. These hazard-based approaches were more interested in the endogenous characteristics of the system as compared to exogenous features; for example research focused on technologies for sustainable food production in developing countries' ecosystems and paid less attention to social issues (Chen and Kates, 1994; Parry et al., 1999) and the deployment of resilience infrastructure to protect the environment and people in Coastal Regions (Jacobs, 1996; El-Raey et al., 1999; Smith, 1999; Kelly and Adger, 2000). Soon scholars began to realise that people were still suffering the impact of climate change such as droughts and floods in the face of advanced technological deployment. The deficiencies were attributed to separating nature from the human system.

Other scholars characterised adaptive capacity as an integral part of social, economic, political and nature (including climate change) events that together established conditions which stimulated and influenced adaptive response, adaptive actions, and responsive adjustments (Tobey, 1992; Onyeji and Fischer, 1994; Reilly et al., 1994; Leary, 1999). These adaptive responses, actions, and adjustments were distinguished in terms of duration: short term 'adjustments' and more permanent long-term 'strategic plans'. Adjustments were daily, weekly or seasonal tactical strategies in a system in response to an immediate stimulus of management decisions, e.g. behavioural change and flexibility in decision-making over asset base. Strategic actions represented more enduring, often anticipatory, actions which were made to support longer term adaptation and which altered the nature of activity in some way, e.g. policy and governance reforms and technological intervention (Smithers and Smit, 1997). These adjustments and strategic actions were adaptive capacity which in practice are spontaneous or planned, carried out in response to or in anticipation of changes in conditions (IPCC, 1995).

Yohe and Tol (2002) characterise adaptive capacity in different ways: first, the range of available technological options for adaptation; second, the availability of resources and their distribution across the population; third, the structure of a critical institution, the derivative allocation of decision-making authority, and decision criteria that would be employed; fourth, stock of human capital including the definition of property rights; firth, the system of access to risk spreading process (e.g. livelihood diversification); sixth, the ability of decision-makers to manage information and the process by which these decision-makers, themselves make decisions. Yohe and Tol argue that adaptive capacity characterized above depends on the decision-maker's perception of vulnerabilities and their significant impact on livelihoods.

Another group of scholars, including Adger and Kelly (1999), placed adaptability within 'the architecture of entitlements' (p. 256). This perspective extends the concept of entitlements, developed within neoclassical and institutional economics (see subsection 2.2.2), and connects it with the broader political economy. Adaptive capacity was considered as socially entrenched and determined: for example, adaptive action at the micro-scale is facilitated or constrained by extra-local actors' actions and their institutions (Pelling, 1999; Adger et al., 2001). This group demonstrates how global networks go hand-in-hand with local scale adaptive capacity. It attempts to account not only for local response within a vulnerable community but also for the associated patterns of global networks that create zones of inequalities regarding access to entitlements, as highlighted by Yohe and Tol above (Pelling and Uitto, 2001). Growing international political-economic interconnectedness, which is influenced by the greater role of the market, has to a large extent undermined traditional coping mechanisms rather than enhancing them because of conflicting interests (Pelling et al., 2002: 298). Globalization is reconfiguring life for indigenous populations, with new ways of coping with disasters eroding social capital due to rapid urbanization. Pelling et al. (1999) argue that there is evidence of differential access to resources and capacities to cope: the rich have always had access to resources because they have benefited from the influence of global institutions and emerging markets.

Pelling and High (2005: 312) have broken down adaptive capacity into two parts: adaptive capacity directed specifically at climate change and interventions directed at background stress which have an impact on climate change vulnerability, that is, where social capital is used to generate material interventions directed at reducing vulnerability to climate change such as using collective action to raise the level of river embankments; using social capital to

generate material interventions that respond to background stress; investing in children's education to enhance their human and social capital to increase familial resiliency to future socio-economic risk; using social capital to generate institutional modifications that respond to climate change stress; an individual building her/his social capital with the aim of generating enhanced access to resources for future material interventions; or using social capital to generate institutional modifications that respond to background stress (Pelling and High, 2005). It was from these debates that the Intergovernmental Panel on Climate Change (IPCC) adopted the first working definition in 2001 in an attempt to harmonise the understanding of adaptive capacity.

Thus, the literature on adaptive capacity regarding climate change contains numerous definitions. McCarthy et al. (2001) defined adaptive capacity regarding climate change as 'the ability of the system to adjust to climate change, moderate potential damages, take advantage of opportunities, or cope with consequences'(p. 21). Meanwhile, the IPCC's definition is based on hazard models, e.g. the pressure and release (PAR) model, which identifies environmental and social forces that relate to adaptive capacity. It is mindful of the hazard to which the system is exposed, its sensitivity, and adaptive capacity (Wisner et al., 2004). Understanding adaptive capacity in this way is similar to resilience in SES (Adger, 2006). The IPCC's definition, therefore, faces similar criticisms: firstly, its assessment has been dominated by quantitative methods that tend to neglect human systems in mediating determinants of adaptive capacity. Secondly, it focuses on the ability of people to cope with the hazards once they occur, by drawing upon exogenous resources, thus ignoring the environment upon which the natural resource dependent communities rely (Eriksen and Silva, 2009). There are, therefore, varying definitions, as noted in Table 2.1, and the IPCC's

definition is by no means the same as some of the definitions used by prominent scholars studying climate change adaptation. Indeed, the IPCC (2001) indicate that knowledge about adaptive capacity is still deficient and in its infancy.

Table 2.1: Definitions of adaptive capacity

Author(s)	**Definitions of adaptive capacity**
Adger and Vincent (2005)	The vector of resources and assets that represents the asset base from which adaptation actions and investments can be made.
Adger (2006)	The ability of a system to evolve in order to accommodate environmental hazards or policy change and to expand the range of variability with which it can cope.
Pahl-Wostl (2009)	The ability of a resource governance system to first alter processes and if required convert structural elements as response to experienced or expected change in the societal or natural environment
Saavedra and Budd (2009)	Is learning to live with change and uncertainty; nurturing diversity for reorganization and renewal; combining different types of knowledge for learning; and creating opportunities for self-organization.
Gupta et al.(2010)	Adaptive institutions encourage actors to learn; they permit society to question socially embedded ideologies, frames, assumptions, claims, roles, rules and procedures that dominate problem solving.
Nelson et al. (2010)	An emergent property of the diverse forms of human, social, natural, physical and financial capital from which rural livelihoods are derived, and the flexibility to substitute between them in response to external pressures.

The framing of definitions of adaptive capacity by various authors in Table 2.1 demonstrates the existence of variations and disagreements among researchers. Such variations make the concept nebulous and difficult to measure, although this uncertainty has also contributed to

the development of new understanding (Smit and Wandel, 2006). Thus, for nearly two decades now, adaptive research has been greatly influenced by debates on policies and programmes on climate change which saw a growing interest in adaptive capacity as a measure of the vulnerabilities of nations, regions and communities and of their abilities to cope with climate variations. This interest has been driven mainly by recent understandings of the determinants of adaptive capacity: namely, economic resources, technology, information and skills, equity, infrastructure, and institutions. These are not independent of each other, nor are they mutually exclusive (McCarthy et al., 2001; IPCC, 2007).

Most research in this area targets developing countries, particularly the least developed countries, because they are assumed to have less capacity to adapt than do developed countries. Hence, many research activities have focused on improving policy targeting resources to most vulnerable communities, largely at the national level (Kelly and Adger, 2000; Vincent, 2004; Brooks et al., 2005; Vincent, 2007; Schipper et al., 2008). In this regard, the IPCC adopted the Adaptation Policy Framework (APF) to democratize the process of adaptive capacity building after being predominantly top-down and characterized by maladaptation. The APF adopted a flexible approach through which users of adaptive strategies could clarify their own priority issues and implement responsive adaptation strategies, policies and measures. This connected with most definitions in Table 2.1 by Pahl-Wostl (2009), Saavedra and Budd (2009), Gupta et al. (2010) and Nelson et al. (2010) that are pro-governance. This is unsurprising as it has become evident that many problems are not purely associated with accessing, having or lacking resource endowments in both developed and developing countries, but rather the result of governance failure (Adger et al., 2009; Pahl-Wostl, 2009).

A review of the climate change adaptation debate by one of the authorities in the field, Neil Adger, has led to a fundamental change in understanding adaptive capacity from the architecture of entitlements and political ecology to governance (Adger, 2003; Adger, 2006). Adger argues that the challenge of adaptation is about who, how and when to act in the face of extreme climatic events. He suggests there is growing awareness that adaptive capacity is 'multifaceted' and not 'simple' as models suggest (Adger et al., 2009: 5). Because governance permeates various conceptualization of adaptive capacity, what is required is 'cross-fertilization' of various approaches to yield new insights (Adger, 2006: 272). Adger aimed to develop a robust and credible lens of understanding adaptive capacity, one that could incorporate all antecedents of adaptive capacity conceptualizations. He envisioned that the robust approach would incorporate governance in order to understand better the mechanisms that mediate vulnerability and promote adaptive action. Governance permeates all conceptual frames of adaptive capacity. Hence it offers a common ground for consilience and integration (Adger, 2006).

For its part, the concept of 'governance' is conceptualized in many ways. Lebel et al. (2006) conceive governance as laws, regulations, discursive debates, negotiation, mediation, conflict resolution, elections, public consultations, protests, and other decision-making processes. Stoker (1998) views governance as a complex set of institutions and actors that are drawn from but also beyond government creating the conditions for ordered rule and collective action by which individuals make decision and share power. For Rhodes (1996) governance is a self-organizing, inter-organizational networks. Rogers and Hall (2003) characterize governance as the relationship between society and its government. Governance is characterized by multi-level decision-making based on negotiations in multi-level institutions

in which formal institutions frequently play the dominant role regarding regulatory processes. Governance is a process across actors and scales of decision-making, finding solutions to problems, making choices and trade-offs and jointly creating a vision and direction for the future. It also encompasses management, that is the operationalization of this vision, and monitoring which provides feedback; it incorporates synthesis of observations in order to understand current situation, and to seek solutions to present situation and the perceived future (World Bank, 1991).

Although these definitions of governance are predominantly applied within national regulatory regimes, they can be applied at the local scale. Bell (2002), for example, describes governance as the use of institutions, structures of authority, and even collaboration to allocate resources and coordinate or control activities in society. At the local level, governance is about decision-making regarding asset portfolios of individuals and households. It is also about relations between local and external actors, higher-level decision-making bodies, and organizations. Governance is about sharing roles and responsibilities of individuals, households and communities within defined boundaries (Agrawal, 2010). Concepts of governance indicate the various ways through which power is exercised in a society, specifically who has influence in society. Pahl-Wostl (2009: 356) has argued that efforts to separate may not do justice to the complexity of real-world governance regimes. Indeed contemporary debates show that researchers – including prominent scholars, e.g. Bakker (2003), Rogers and Hall (2003), Folke et al.(2005) and Norman and Bakker (2008) – are promoting an encompassing conceptualization of governance following the growing realisation of the complexity of societal dynamics, particularly at practice level.

In this sense, it is possible to identify different modes of governance or 'governance regimes' which might be categorised into: regulative, normative and cultural-cognitive regimes. Regulative governance regimes are identified with formal legal structures, regulatory frameworks, and formalized professional rules of good practice as typically codified in professional handbooks. They are characterised as top-down. Normative regimes are characterised by informal societal norms, shared but not cast in stone, regarding rules of good practice. Cultural-cognitive regimes can be identified through paradigms that are strongly influenced by mental models and contextual understanding; so too are their derived solutions (Pahl-Wostl, 2007; Pahl-Wostl, 2009). Within multiple modes of governance, individuals and institutions, and public and private actors participate in the formulation, implementation and management of their common affairs in established networks at multi-level.

Gunderson and Holling (2002) have indicated that understanding responses to periods of change necessitates knowledge about nested and hierarchical decision-making in resource governance. Folke et al. (2003) identified attributes of adaptive governance regime by characterizing four critical factors that interact across temporal and spatial scales. They were: learning to live with change and uncertainty; combining different types of knowledge for learning; creating opportunity for self-organization toward social-ecological resilience; and nurturing sources of resilience for renewal and reorganization (Folke et al., 2003: 252-287).

Literature on governance in the context of climate change adaptation therefore shows that building adaptive capacity against the backdrop of resource scarcity and existing policy constraints can prove a difficult and complex task. Adaptive capacity is a continuing process where coordinated adaptive action may be taken but where tensions or conflicting interests

can also be entrenched. Moser (2009) argues that regulatory regimes in practice can both inhibit and encourage adaptation. The mismatch between exogenous and endogenous adaptive strategies and preferences for adaptation framed at adaptation and policy scales are evidence of this. It has been argued that such tensions can be resolved possibly through the integration of context-based knowledge and institutional governance into regulatory governance regimes. This can help adapting people and institutions to agree on what is perceived to be in their interest and to improve on the effectiveness of strategic adaptive strategies (Nicholson-Cole and O'Riordan, 2009).

As noted previously, relying on one single theoretical perspective may give the illusion of perfect adaptive capacity and its application. However this does not occur in practice. Theories provide good guidance about actors' relationships and their arrangement in relation to resource endowments but governance transcends all of the presented theories and changes the dynamics between them also. Pahl-Wostl (2009: 355) has defined adaptive capacity as the ability of governance systems to deal with uncertainty and surprise as an essential requirement for their sustainability in times of increased unpredictability due to climate change and global change. Although external institutions and actors are central to adaptive capacity enhancement at local level, their mode of governance has frequently not been dynamic and has suffered decades of command-and-control or top-down approaches. This approach often tends to favour engineering solutions and neglect traditional capacities embedded in informal institutions, which may lead to maladaptation (Agrawal, 2008; 2010).

Agarwal argues that while adaptive capacity to climate change is debated as a state function and as the responsibility of external actors, adaptive actions are highly local and depend on

institutional partnerships between formal and informal institutional governance norms. Agarwal (2010) also argues that most governance models are designed with sedentary populations as their target because they fail to capture the dynamic nature of adaptive actions on the ground. In addition, these static models tend to focus on regulative governance regimes and do not include informal institutions' governance regimes. These local institutions are household, traditional and political leaders, and NGOs are crucial to the successful pursuit of local and externally facilitated local adaptive practices and actions. Often where external intervention is present, it is channelled through local formal and informal institutions to enhance adaptive capacity of individuals.

Anderson et al. (2010) argue that governance institutions tend to structure assets differently for men and women and for groups defined by class, power, and age or occupational group. In an agrarian society undergoing reforms, cattle keepers will have access to a different set of coping mechanisms than farmers growing crops because policies tend to favour crop intensification and modernisation. Furthermore, within groups there are observed disparities regarding access to resources, e.g. private land rights clearly favour the adaptive strategies of those who can command economic assets, especially those with large incomes and authority in the society than traditional pastoralists and agro-pastoralists (Anderson et al., 2010). At the local level, adaptive capacity is characterized by adaptive orientation and readiness to adopt flexible strategies that will reduce vulnerability to climate change and other contingencies. At individual and household levels, moreover, adaptive responses to climate change and other stresses are mediated by multiple factors. Most adaptive actions that individuals, households or communities make depend on perception of change locally, such as whether people have experienced that type of change, whether there is a repertoire of responses to that specific

change, and the combination of assets and opportunities to which they have access. These adaptive responses which have been observed in developing countries are also common in Africa, to which I now turn.

2.4 Adaptive capacity and climate change in Africa

The literature on adaptation to climate change in Africa tends to focus on two issues: the role of sustainable livelihoods and the question of governance. The sustainable livelihoods literature has focused on the availability of determinants or the asset base needed for adaptive capacity to take place, such as technology, necessary information and knowledge, capacity to access and capacity to act. Attention has also been paid to local adjustments to ameliorate livelihoods during and after disruption. These local adjustments are grouped into five categories: mobility (the distribution of risks and opportunities across space and time), storage (distribution of risk across time), communal pooling, diversification, and market (Agrawal, 2008; 2010). The fivefold classification of adaptive capacity is ideal for Africa because people are continuously practising their adaptive capacity skills, especially because so much of Sub-Saharan Africa faces extreme irregularity in precipitation, with high recurrence of drought and rampart poverty (Boko et al., 2007). Scholars have argued that people living in the Sub-Saharan region have adapted their practices and actions to achieve some degree of sustainability in their livelihoods.

Research on household livelihood strategies used to recovering from shock shows that the most common adaptive strategy is diversification of livelihoods. Diversification pools vulnerability across the asset bases of the individual, household or community. Pooling can occur in relation to tangible and intangible resources. Diversification in household sacrifices

some dividend in exchange of greater livelihood security provided by diversification. For example, Corbett (1988: 1104) notes in Ethiopia how poor households were found practising a sequencing strategy portfolio of diversification. But there are other practical diversification strategies, such as growing different crops within and across seasons that can adapt to water variations (e.g. staggering sowing seed) (Roncoli and Kirshen, 2001). Other strategies include selling labour and occupational skills development through formal training. For example, many pastoral households in Africa educate their children to acquire formal skills and training that would allow them to sell labour. Selling labour acted as a proactive adaptive strategy to recurrent climate variations and dwindling grazing and water resources by pastoralists. The ability of household members to adjust eating habits due to scarcity of food and water was found to be an adaptive response by poor households in famine times (Corbett, 1988). Adoption of rainwater harvesting including ground and above tank harvesting, dams and water ponds is listed as one of the specific adaptation strategies that rural populations in Sub-Saharan Africa undertake to buffer against climate related weather events (Kahinda et al., 2007). Alternating water sources between rainwater harvesting and boreholes combined with seasonal water use adjustments helps to spread risks and increase adaptability of communities. Nyong and Kanaroglou (1999) found that households in rural Nigeria were using less water during the dry season (26.1% below standard 21L per day by WHO) and more during the wet season (44.9% more). In addition, households alternated water sources and travelled long distances to obtain good quality water in the wet season.

Although diversification is well integrated into traditional practices, scholars demonstrate that diversification is not mutually exclusive from mobility or independent adaptive strategy (Osbahr et al., 2008; Nielsen and Reenberg, 2010). Mobility is the systematic and purposeful

movement of people alongside matter (tangible and intangible) in time and space. Mobility is a vital adaptive strategy for vulnerable people to multiple contingencies including climate change (Agrawal, 2010). Movement of people has been seemingly one of the most natural adaptive strategies socio-biologist and anthropologists identify to enable humans to adapt and secure livelihood (Weiss and Mann, 1990). Mobility helps people to get out of vulnerable places when they are affected by multiple pressures, including climate change and a lack of access to asset stocks for securing livelihood (Weiss and Mann, 1990; Nyong et al., 2007). People may migrate to a new place to diversify their livelihood base. Although mobility has been seen as a problem in global debates on social insecurity, mobility is a significant adaptive strategy in climate change community groups dependent on natural resources (Tacoli, 2009). At local level mobility is a mechanism of distributing risks across space and time. Movements can be classified in many ways: short –term versus long-term, those resulting from sudden impacts versus those resulting from regular seasonal variations, predictable and unpredictable (Agrawal, 2008; 2010). Mobility is also a traditional adaptive strategy that can be used to reduce the pressure on resources such as pasture and water through the seasonal movements for rural households. Thus, nomadic herders move from the dry regions during the dry season to the wetter regions. They return to the drier regions during the wet seasons. This is a common practice in areas of the Sahel (Nyong et al., 2007). In Limpopo region, Mozambique, in dry season many families move to low wetlands to graze their livestock and cultivate crops. They return to the upland during the wet season after harvesting their crops to avoid floods that occur during the wet season (Osbahr et al., 2008). Mobility seems to be a dependable response by poor communities to adapt with seasonal predictable events and pool risks across space and time.

2.4.1 Adaptive capacity is heterogeneous and dynamic in rural Africa

The literature so far indicates that adaptive capacity at the micro-scale in rural Africa is heterogeneous mainly because individuals and households simultaneously respond to both direct and (more importantly) indirect impacts of climate change[1]. However, the literature has tended to concentrate on agriculture-based adaptive strategies with less attention on rural water management, including domestic water supply needs. Yet, security of rural water supply is critical for the realisation of the wider adaptive capacity at the micro-scale (de Wit and Stankiewicz, 2006). As a result, limited research has been undertaken on how adaptive capacity intersects with rural water management at the micro-scale in respect of the model of rural domestic water supply promoted since the 1990s in Sub-Saharan Africa to involve multi-level relations and decision-making dynamics.

Focus on water governance has been central in understanding adaptive capacity to climate change already underway. In the context of governance, Pahl-Wostl (2009: 355) describes adaptive capacity as 'the ability of a governance regime to alter its processes and if required convert structural elements as a response to experienced or expected changes in the societal or natural environment in order to adapt'. Agrawal (2010: 185) also argues that the success of adaptive strategies at the scale of adaptation is dependent on individuals and households, in part, but also on networks and institutional relationships, institutional articulation of access and availability of resources and power or influence. She further argues that formal institutions (including policies) and organizations interact with local institutions to promote capacity of informal institutions by creating incentives which benefit individual and

[1] Direct impacts include climate change stimuli such as frequent drought and increase in temperature, while indirect impact refer to broad social, economic, political and ecological conditions that affect adaptive capacity.

collective actions. Adger (2003) also points out that adaptive capacity may be enhanced within policy, formal and informal institutional arrangements associated with how resources are governed at local level. For instance, in their work in rural South Africa, Osbahr et al. (2010) note the significance of governance regimes with regards to coping abilities at individual and community scales by emphasizing that coping mechanisms of individuals at local level are not free from external governance regimes. At local level, individuals may be connected to formal and informal institutions that significantly shape their adaptive capacity. Using the case of Mozambique, Osbahr et al. (2008) also show how local people's perceptions about connections with traditional institutions, elected political leaders, non-governmental organisations and government departments, and their significance regarding actions can facilitate adaptive capacity. They also observed that conflicts existing between formal and information institutions could have differential limitations on individuals' level of success in reorganisation and resumption of normal livelihoods. In another example, Chikozho (2010) argues that researchers and experts seem not to learn adequately from local poor farmers' innovations and localised knowledge, and further that there is lack of knowledge integration between local people's indigenous knowledge and external knowledge, which when fused could lead to hybrid innovations that could leverage local adaptive capacity. He calls for deliberate attention to processes through which policy strategies and practices are governed at local level.

The literature also notes that sudden changes in practice and priorities at the micro-scale by aid agencies and NGOs could disrupt processes of adaptation (e.g. West et al., 2008). In Bukina Faso, for example, sudden withdrawal by aid agencies/NGOs created job losses, while the introduction of new varieties of crops that were drought resistant failed because of

lack of local knowledge on pests. The new crops were susceptible to pest and diseases and costly to acquire by the impoverished farmers (West et al., 2008). Yet, consultation with locals by the NGO could have prevented this situation. Hence, the ways in which climate change policies emerges in relation to broader development policy remain central to the governance debate in Africa (Chuku, 2010). In his study about agricultural modernization and adaptation in Uganda, James (2010) also notes that at individual farmer level, uptake of adaptive strategies is not just automatic, as may farmers take time to weigh external strategies against existing local circumstances and asset bases including knowledge, information, labour and income. He further observed that external strategies designed to increase aggregate benefits to poor households, such as high yielding crop seeds, ignore the rural population's limited financial and economic ability to sustainably uptake the new technology.

More literature from Africa has also indicated that local and externally developed adaptive strategies are not mutually exclusive or inclusive but depend on each other. For instance, in rural Ghana, as Derbile and Kasei (2012) demonstrate, rural poor smallholder farmers developed local capacities, but which turned out be inadequate due to the lack of better-quality policy interventions and support. Stringer et al. (2009) also found contradictions between policy strategies and practical adaptive strategies of communities, although some integration of local and policy strategies were noted in Botswana, Malawi and Swaziland. It has also been argued that local adaptive capacities can act as a 'platform' for creating integrated policy strategies for addressing vulnerability, and therefore, are inseparable from contemporary development adaptive strategies (Mortimore, 2010).

One of the aspects of adaptive capacity at the micro-scale is the relationships and interactions between and among individuals, groups, institutions or communities. Some literature has referred to this as *social capital* (Adger, 2003). Through these relationships, special groups take collective action that aims to harness their resources and avert risk. Governance arrangements existing in a particular context shape the ability of individuals, groups or institutions to network and adapt differently within and outside the community (Ziervogel et al., 2006; O'sbahr et al., 2008). For instance, during flood in Mozambique 2000 individuals, households and communities were not equally affected but the rich individuals and households were more adaptable than the poor because rich farmers had asset stocks such as pasture and water, food and cash to secure their livelihoods (Osbahr et al., 2008).

While networks may bring benefits, they may also be weakened by factors that go beyond trust such as geographical location vulnerabilities and socio-cultural differences. Regarding locational vulnerabilities, Codjoe and Owusu (2011) point out that the capacity to cope with perturbation is variable from one village to another as does the livelihoods of these people; one village may have high availability, access and utilisation of (natural) resource endowments, while another village could have the lowest availability, access and weakest utilisation of these endowments. These variations in adaptive capacity may also exist within a single village because of differential capacities among individual households to produce and/or purchase or own livelihood assets. Trærup and Mertz (2011) also argue that complexities caused by differential climate change impact within the geographical area may lead to heterogeneity in coping mechanisms at a local level for example, the type of crops grown, ability for sale of labour or sale of an asset base or dependency on social capital. Regarding the socio-cultural dimension, Bryan et al. (2009) found that in Mozambique, class

position and differences according to gender, age, health and education at farm level contributed to differences in adaptive capacity, the rich and educated farmers had access to new knowledge and could afford better technology than the poor and uneducated farmers . Unpacking adaptive strategies (including local) that are often available among the villagers, or by extra-local actors, is constrained by cultural barriers, limited access to financial resources and poor infrastructure development such as roads and markets (Trærup and Mertz, 2011; Codjoe and Owusu 2011). Regarding cultural barriers, literature shows that rural individuals are faced with challenges when it comes to decision-making processes regarding for instance whether or not to compromise their traditional crops and adopt new technologies and new crop varieties that are efficient in water use and drought tolerant (Nielsen and Reenberg, 2010). Hence, understanding adaptive capacity is complex at adaptation level and traditional adaptive strategies, such as diversification, social networks and mobility are not independent from local informal and formal institutions which govern the resources.

Based on the foregoing discussion, I observe that indeed the literature on adaptive capacity focuses mainly on agricultural-based resources management including water for production. I argue that emphasizing agricultural and water management adaptive capacity as themes of paramount importance downplays other significant themes within the livelihood basket, such as water for drinking and domestic use. Lack of a comprehensive picture on how water is managed may have far reaching implications not only on human health but also on farm productivity and nature and outcomes of human interactions. There are already major concerns about water access and water security in Africa, where those using surface water for drinking and domestic purposes are estimated to be 187 million people, 94% of whom majority are rural inhabitants (WHO and UNICEF, 2012). Target 7(C) of the United Nations

Millennium Development Goals (MDGs) is reducing by half the proportion of people without adequate access to affordable water by 2015 (UN, 2012). However, differences in regions and countries undermine reported progress on the ground. Governance dynamics in developing countries, specifically those in Sub-Saharan Africa continue to be reported as the major limitation to successful adaptation regarding water resources (Boko et al., 2007).

Broadly, governance regimes involve complex regulatory approaches and interactions regarding political, social, economic, management, biophysical and administration systems in order to deliver water services across-scales (Prasad, 2007; Pahl-Wostl et al., 2008). It is through these social-political institutions that local people voice their interest, contribute to policy strategies, participate in decisions concerning which and when actions should be taken, jointly manage services and facilitate dual accountability regarding actions.

Debates informing adaptive capacity regarding water governance in Africa can be viewed as regional and national level governance, and rural or local level governance. However, regional and national water governance has received much attention in Africa compared to rural water management in the literature (de Wit and Stankiewicz, 2006). Mukheibir (2010) argues that national level access to water has tended to dominate the debates and policies e governments and aid agencies, including NGOs are concerned with the wider problem of water security. Consequently, considerable literature, such as the Orange Basin River, South Africa (Sullivan, 2011) and national water governance adaptive capacity (K'Akumu, 2007; Mukheibir, 2010) has tended to address policy and institutional arrangements, reforms and delivery of appropriate technologies to improve safe water access and security in order to enhance institutional adaptive capacity. Some of the contemporary debates regarding regional

water adaptive governance to climate change argue that water governance is a local issue and needs an adequate understanding and appreciation of local water dynamics (Jacobs, 2012).

Generally, the literature seems to show that to associate poor or limited access to water with physical scarcity due to climate change alone can be misleading. Climate change impact is critically one of the causes, but it is not a major feature threatening water security at local level. Watkins (2006)argues that weak policies threaten water security and access because practice has demonstrated that people can institutionally, socially and geographically be denied access and security to water. Hence, there is growing literature within climate change that accepts physical water scarcity but also strongly advances the view that the water scarcity that the world is facing is socially constructed and therefore, a governance issue (Boko et al., 2007). Scholars have viewed water scarcity due to climate change as a likely source of tension and conflict or water wars at national and regional scales in Africa (Boko et al., 2007).

At the household level, water governance is complex to understand when compared to global and national contexts. At the micro-scale, decisions and actions change rapidly depending on the nature impacts and social interactions at any place and time (Agrawal, 2010). Some studies in Sub-Saharan Africa, specifically in urban situations, have reported that water governance at household level involves allocating water to various productive uses including water for irrigation of crops, kitchen gardening, brewing and livestock watering (Thompson et al., 2000; Makoni et al., 2004). In another example, the literature seems to show that at the household, water governance is as heterogeneous as in agricultural adaptive capacities. For instance, at the household, water management pays attention to multiple issues. Such issues

include access, allocation, adjustments, tension negotiations, gender and cultural issues, connections with extra-local actors and the wider political economy. It also heterogeneous in terms of decision-making about available water at home across competing water needs such as drinking, cooking, hygiene and livestock (Buor, 2004; Geere et al., 2010).

Furthermore, drawing upon literature on agricultural adaptive capacity, water governance at the local level may be shaped by context-specific and socially accepted arrangements of institutions (formal and informal). Cleaver and Toner (2006) illustrate that at local level, access and use of water is complex, and is mainly determined by regulative norms, informal norms and cultural factors, land and water rights, social relations between different gender groups and water market (Cleaver and Toner, 2006). Available evidence suggests that the way formal and informal water governance regimes operate in most parts of developing countries shows tensions at the interface (Singh, 2008)that connects with 'platforms' in climate change (Mortimore, 2010). Singh argues that the failure of formal institutions to recognize and build on already existing traditional institutions and norms has contributed to further refusal of formal governance initiatives.

Literature about land grabbing has also associated land grabs with water (Ruettinger et al., 2011). Land grabs are known to restrict mobility especially for pastoral communities in Sub-Saharan Africa. For example, the 'great land grab' in Uganda has created a mobility barrier of for cattle keepers and limited access to water and other livelihood asset bases (Matsiko, 2012). Climate change is expected to alter present water resource governance at the local level because there are already on-going pressures regarding water at this level and processes of enclosure as discussed in detail in Chapter Six. Therefore, the adaptive capacity of poor

individuals or households is hardest when climate change impacts on water and on other livelihoods such as land. In such cases, adequate governance competencies are necessary for this group if they are to respond and adapt. Boko et al. (2007) have indicated that climate change will aggravate relationships, change social dynamics and impact on the cost of accessing water in terms of governance efforts invested at the micro-scale.

I argue that addressing adaptive capacity, within the domain of water governance, requires a shift in thinking that recognises access and security as limited by policy and institutional reforms, coupled with investment in infrastructures for abstraction of water in fixed modelled manner. I also argue that the subject of water access in the face of climate change has to move from simple supply-and-demand to more complex issues regarding governance at practice and action levels in order to characterize and understand nature of relationships and tensions in relationships between local people and extra-local actors in context of adaptation to climate change at the micro-scale. Further, I argue that contextualizing multi-scale relationships and decision-making might provide useful insights into adaptive actions to multiple pressures at the micro-scale that may also inform policy practice in adaptive governance in rural communities, Africa. I have three, but interrelated, concerns. My first concern is that there seems limited attention to issues of intra-household and extra-household water governance at the micro-scale, specifically in rural Sub-Saharan Africa, with regards adaptive capacity to climate change. My second concern is related to some of the challenges facing water governance research, in particular, the deployment of static water governance models that tend to focus on regulative frames and fail to capture the micro-scale governance dynamics.

Finally, I have observed across most of the literature reviewed that most of the approaches and methodologies used to assessing adaptive capacity to climate change that are predominantly static conforming to static frameworks of governance. My concerns raised here might have been answered in any adaptation study similar to mine, if by accident rather than design. However, in my scanning of published research in Sub-Saharan Africa I have found few instances of explicit use of 'dynamic assessment' – context-sensitive methodologies – to characterize adaptive capacity to water management at the micro-scale. This should not be taken as indicating that the research blending water management and seasonal variation has not been discussed before (for useful primer, see Nyong and Kanaroglou, 1999). I argue that improved understanding of water access and security to domestic water can greatly contribute to the reduction of household poverty and health problems afflicting rural Africa.

2.5 Summary

The general aim of this Chapter has been to introduce and provide a basis for understanding adaptive capacity, specifically with regards to climate change. What should be clear from the discussion is that, although there are diverse conceptualizations of adaptive capacity, it can be understood by considering different theoretical underpinnings in an inclusive manner. Adaptive capacity does seem to be a nebulous concept but analysis of the literature discussed here suggests that any attempt at understanding the adaptive capacity of rural populations in Africa must, at the very least, strive to focus on heterogeneous practices and actions at the micro-scale.

This Chapter has also discussed some of the problems associated with adopting a rather static view of adaptive capacity. In endeavouring to reflect the dynamic of adaptive water governance at the micro-scale, such as adjustments to livelihood asset bases or mobility adopted to spread risks, it is necessary to try to capture the dynamic nature of heterogeneous practices and actions. Adaptive actions are not static but rather are dynamic in space and time. Adaptive practices are dependent on the social connections people have to reorganize and transform their assets and livelihoods after suffering from contingencies at a particular place and time (Brockhaus and Kambire, 2009). Adaptive capacity involves mobility, doing different things at the same time, changing activities over time, and carrying out activities in different locations (Goulden et al., 2009). We cannot continue concentrating on addressing the issue of adaptive capacity simply by expanding infrastructure, such as boreholes and shallow wells and modelled governance regimes (regulative governance systems). There is an urgent need to shift attention to more flexible understandings of adaptive capacity. Based on my reading of the literature, moreover, I argue that the methodologies scholars have tended to deploy when researching adaptive capacity in Africa have not been sufficiently context-sensitive or dynamic enough.

Based on the above, therefore, my aim in this dissertation is to explore a dynamic assessment of adaptive capacity that might contribute to the field by helping actors at the micro-scale communicate their adaptive strategies more widely and therefore enabling external actors to improve how they plan their adaptive strategies. Thus my research aims to:

i. Contribute to the on-going development of knowledge about how adaptive capacity is perceived, experienced and managed by the communities, households and individuals at the micro scale in rural Africa;

ii. Explore how spatial analysis techniques available in geo-information systems can be used to explore rural communities' adaptive capacity in climate change at micro-level.

CHAPTER THREE

A DYNAMIC ASSESSMENT OF ADAPTIVE CAPACITY

3.1 Introduction

The previous chapter discussed theoretical conceptualizations, underpinnings and convergences of adaptive capacity generally and specifically about climate change. I have argued for an integrated view of understanding the adaptive capacity of rural communities in Africa to deal with climate change. In this chapter, I expand on my methodological approach which uses PGIS and ethnography. I have called this combination a 'dynamic assessment'. The chapter begins by discussing contemporary approaches in assessing adaptive capacity, specifically in developing world contexts. I explain why I view current approaches as 'static' in the manner in which they are deployed. The chapter then discusses my methodological approach, which is followed by an overview of my methodological strategy and a discussion of how I went about my dynamic assessment of adaptive capacity.

3.2 Conceptual view of the methodology in relation to assessing adaptive capacity[2]

My research is interested in the micro-scale, that is, on the daily practices of individuals in rural communities in Africa. I am interested in trying to shed light on how people in a place such as

[2] Assessing adaptive capacity to climate change at the local level is a complex issue (Jones et al., 2010). However, there is a growing literature on how to make just such an assessment. This literature indicates that adaptive capacity assessment is explicit about scale (spanning from individual to global scale) regarding its understanding (Adger et al., 2005; Smit and Wandel, 2006).

Makondo might try to deal with climate change. I am especially interested in how they might deal with longer dry periods because this is what climate models are predicting for this region of Sub-Saharan Africa. But although my interest is in the micro-scale, I still want to pay attention to extra-local institutions that structure or mediate adaptive actions.[3] As I noted in Chapter Two, adaptive actions are not static but rather they are dynamic in space and time. Adaptive action involves doing different things at the same time, changing activities over time, and engaging in activities in different locations (Goulden et al., 2009). These practices are embedded in local knowledge about (natural) resource endowment but also in the social connections that people draw upon (Agrawal, 2010). Action is dynamic. Consequently, trying to understand adaptive capacity requires a dynamic, integrated but also a grounded method of trying to assess it. Understanding micro-scale adjustments, movements of materials, and people's reactions entails paying attention to practices, which in turn requires a methodology that can discern what people are doing in their daily lives. What is needed is a context-sensitive methodology that can capture the distribution of resources in space and time and provide an opportunity for individuals and communities to explain and document their coping strategies, alongside their knowledge about climate variation. As I now discuss, however, the literature researching adaptive capacity to climate change has not been conducted in this manner.

The vast majority of research on adaptive capacity to climate change in Africa tends to use surveys to attempt to assess adaptive capacity (e.g. Below et al.(2012), Tambo and Abdoulaye

[3] As Jones et al. (2010 argue, adaptive capacity at individual level is dependent on adaptive actions of people and their connections with and the actions of, extra-local actors. Outstanding difficulties of measuring adaptive capacity at local level seem to still persist (see, Vincent, 2007 and Jones et al., 2010).

(2012), Derbile and Kasei (2012), Codjoe and Owusu (2011), Trærup and Mertz (2011), Mertz et al. (2011), Osbahr et al. (2010), James (2010), Hassan (2010), Eriksen and Silva (2009) and Mertz et al.(2009).[4] In addition, far too few studies draw upon ethnographic techniques (e.g. West et al., 2008). These authors reveal that adaptive capacity is heterogeneous: in one place some individuals may have the capacity to cope, while in another place individuals may lack such capacity. In addition, they show that there are tensions between local and external adaptive actions. This literature does not unpack these dynamics of heterogeneity at the micro-scale because of the methodologies deployed.

Such approaches consist of rigorous and logical rules for testing hypotheses and inferring how individuals, institutions and/or governance regimes will adapt in a given scenario. However, surveys, regardless of which particular techniques are used, tend to distance respondents from the process of knowledge production and minimize the benefit the researchers can gain from studying community members' lived experiences. Survey methods also tend to use standardised measures so that the varying perspectives and experiences of people can be fitted into a limited number of predetermined response categories, to which numbers are assigned, with a view to measuring the reactions of a great many people to a limited set of questions. Although such surveys give broad, generalizable sets of findings presented briefly and clearly (Patton, 2002) and facilitate comparison and statistical inferences, over reliance on them limits our understanding because they lack micro-scale details. In addition, given the low adult literacy rates in rural Sub-Saharan Africa (UNDP, 2011), surveys are not always ideally suited in these

[4] Measure adaptive capacity using national indices, surveys, and other models (Smit and Wendal, 2006; Vincent, 2007). Worryingly, the majority of research work published and studied in Sub-Saharan Africa

contexts. Questions around how capable respondents may be to answer often lengthy questionnaires must be considered. Equally, it is questionable whether survey data collection practices regarding adaptation can ever be sufficiently iterative as to capture what people are doing to alter their relations with others and with their environment. Insights and their understanding of the issues under examination are therefore bound to be limited when using surveys alone. There is also the risk that quantitative approaches (e.g. surveys), when used to understand a community, might not generate any positive benefits for the researched community (Kesby et al., 2005).[5] While none of this critique is to suggest that such work should not be conducted, it certainly is to say that scope exists for alternative, more participatory approaches. Further, given that most authors use these sorts of methodological approaches that rely heavily on responses by interviewees as opposed to long-term observations of daily life and practices, I argue that the literature has advanced quite limited understandings of adaptive capacity.

Although participatory approaches bring their own risks and dangers, intensive *qualitative* methodologies, including ethnographic approaches, facilitate the study of issues in depth and detail because they involve approaching fieldwork without the constraints of the predetermined variables of analysis. Ethnographic enquiry is particularly useful because it helps to document the worldview from the point of view of research subjects. Ethnography also enables the researcher to apply a cultural lens to the interpretation of information acquired through interviews and observations. Such an approach aims to represent the lived experiences and

[5] Others use Stringer et al.(2009), Chikozho (2010), Thomas (2008), Twomlow et al. (2008) and Kahinda et al.(2010) engaged in a literature review of this area which involved macro-scale studies.

actions of research subjects. Research then tries to understand human motivations behind adaptive actions taken in any one place and at any one time (Watts, 2001; Moeran, 2006; Wilson and Chaddha, 2009; Fetterman, 2010; Watson and Till, 2010). The application of institutional ethnography can also help to explain inconsistencies between the knowledge of their realities, for example the knowledge of individuals trying to adapt to climate variations and their interactions with external actors such as NGOs and local or national government (McNamara and Morse, 2004). In turn, this sort of approach can help the researcher generate a robust method to understand nuanced contextual issues and tensions (Fetterman, 2010). Through ethnographic study, the researcher can try to understand the issue under examination as experienced through the life of community members. It therefore requires living in the researched community so the researcher can experience the situation and observe the reality in practice and action (Fetterman, 2010).

While an ethnographer is immersed in the community, participant observation dominates data collection techniques: it is seen as the most powerful and central method and strategy of fieldwork (Moeran, 2006). Participant observation is the immersion in a culture which allows the researcher to appreciate multiple perspectives and to engage in different types and sources of data (Moeran, 2006). Moeran (2006: 131) considers participant observation as "the ability to see beyond the social front that informants present to strangers in their everyday lives, to know that there is a difference between 'front-stage' and 'back-stage' behaviour, and to have ready access to that back stage". Practically, it involves the researcher living and working in the community, learning, understanding and seeing patterns of behaviour and actions over time (Fetterman,

2010).The process of participant observation helps reveal data and information, some of which the researched community members might not dwell upon to any considerable extent. This position with respect to the community can allow a researcher to gain an experiential understanding of fundamental cultural practices and daily lives. Moreover, living in the community helps the researcher to internalize the basic beliefs, fears, hopes, and expectations of the people under study (Moeran, 2006; Wilson and Chaddha, 2009; Fetterman, 2010; Watson and Till, 2010). Participant observation is therefore a flexible approach that allows the researcher to pay attention to events as they unfold. At the micro-scale, participant observation sets the stage for more refined techniques such as structured and semi-structured including informant interviewing and questionnaire interviews.

An ethnographic enquiry therefore comprises a number of different data collection methods including interviews (informal and formal interviews), observations and documentary, even use of technology such as digital recorders, video recorders, computers and GPS and GIS. Despite the use of technology, the ethnographic tradition tends to reject formal data collection protocols, preferring to adopt whatever is considered suitable and useful. As Walford (2007: 28) argue, the ethnographic researcher participates, overtly or covertly, in people's daily lives for an extended period of time, watching what happens, listening to what is said, asking questions, while simultaneously collecting whatever data are available to illuminate light on the issues with which the researcher is concerned (Walford, 2007). Ethnography has entails commitments, such as: requiring a research to think oneself into the perspective of the researched, which demands an empathetic process; and it requires the ethnographer to become immersed within the social

setting, close in contact with the researched. Ethnography requires prolonged periods of fieldwork in order for the researcher to infiltrate and be accepted within that setting (e.g. Fetterman, 2010). In addition, ethnographic research recognizes the relativistic status of knowledge, that is, there is no one objective reality but rather a number of realities. Ethnography is an active, on-going process of understanding, during which a particular aspect of the world has been produced through selective observations and interpretations.

Building on the above discussion, I view participant observation as an unsystematic and flexible approach that allows the researcher to pay attention to events as they unfold. Furthermore, participant observation involves direct involvement in people's daily lives, thereby providing understanding of and gaining access to phenomena that commonly are obscured from the standpoint of an nonparticipant (James, 2007: 39-50). James (2007) demonstrates that participant observation is especially appropriate for studies that are exploratory, descriptive, and aimed at generating new understanding and knowing. At the micro-scale, participant observation sets the stage for more refined techniques such as structured and semi-structured including informant interviewing and questionnaire interviews.

In addition to ethnographic methodologies, one area in which a more context-sensitive approach has been developed in recent years is the application of participatory GIS (PGIS). Geographical Information Systems are complex combinations of software and hardware used to collect, store, analyze, and represent spatial data. GIS can assist observations of significant changes in patterns of activities or practices over time and space, such as movements and connections with places

(e.g. Kwan, 2002, Puri, 2007 and Wang et al., 2008). It has a strong association with quantitative geographers conducting statistical analyses of spatial data. It is often criticized for its exclusionary nature, because only experts can begin constructing an effective GIS, often using proprietary software. Further, the 'critical GIS' literature has warned that GIS methods run the risk of marginalizing or excluding some forms of knowledge and logic, particularly indigenous knowledge (e.g. Lake, 1993 , Aitken and Michel, 1995 , Pickles, 1995 , Robbins, 2003 and Schuurman, 2009).

In recent years, however, there has been a move among many practitioners to bring GIS into closer contact with qualitative methodologies, including participatory methodologies such as ethnography. One outcome is the concept of PGIS. PGIS involves making geographical information technology available to disadvantaged groups in society in order to enhance their capacity to generate, manage, analyse and communicate spatial and non-spatial information (Rambaldi et al., 2004). PGIS may take the form of computer, photographs, satellite imagery, Global Positioning Systems (GPS) and in-house GIS (McCall, 2003; Rambaldi et al., 2004; Chambers, 2006; Elwood, 2006) and Participatory 3-Dimensional Modelling (Corbett and Rambaldi, 2009).

One way PGIS can be pursued is via a Public Participation GIS (PPGIS). PPGIS is a web-based GIS public participation system (Peng, 2001). It uses 'cyberdemocracy' to support public participation and online spatial decision support systems (Carver et al., 2001). PPGIS is an Internet-dependent GIS used to aid public participation in decision-making processes (Kingston

et al., 2000) and as a mapping method to collect public data for input into a national planning decision support system (Brown and Reed, 2009).

PGIS also has been widely applied in developing countries, including African countries. This has been aided by falling costs for geo-science technology (Chambers, 2006). The practice often draws upon participatory rural appraisal (PRA) and participatory learning and action (PLA) methods, such as sketch mapping rather than more sophisticated mapping (Rambaldi et al., 2004), also known as 'participatory diagramming' by geographers (e.g. Kesby et al., 2005). Participatory diagramming embodies distinctive sets of knowledge and evidence. Of particular importance is its inclination to local knowledge, which provides a means of assuring the reliability of findings and also, importantly, its attention and preference for visual over verbal data during the research processes.

Participatory mapping and PGIS methodologies, such as sketch maps, seasonal calendars and transect walks, are not final products but rather provide scope for a discussion and help the researcher gather extra data and conduct further analysis in subsequent discussions. As Gonzalez (2000; 2002) has demonstrated, for example, participatory mapping of space at the micro-scale can help researchers to obtain new understandings and impressions of phenomena, such as water management. Further, such approaches can facilitate joint-learning, that is to say both the researcher and research participants learn together about the changes in the management of resources and the role of a range of actors in shaping that management and utilization of resources. Finally, because the outputs are democratically debated, PGIS can enable research

participants to see provisional results of the research, to improve, contest, and interpret them differently. Such a process can help legitimize the findings of PGIS (Chambers, 1994; McCall, 2003; Chambers, 2006).

Thus, in ideal form, PGIS entails a GIS expert working with non-expert respondents to generate and then collaboratively analyze spatial data. Non-experts therefore need to be offered some basic training in data collection and even data entry and analysis, although in practice this is not always possible. Indeed, a critique of PGIS is that ineffective stakeholder participation might lead to questions regarding procedure and process (McCall, 2003; Mayoux and Chambers, 2005; Chambers, 2006), or that "PGIS corresponds to the weakest of the participation intentions and is concerned only with 'facilitating' more 'efficient' implementation. In such applications, a lazy approach is taken in terms of what sorts of indigenous knowledge are collected, and there is usually very little cross-checking ...." (McCall 2003: 569). PGIS can also disempower and become 'extractive' (Chambers, 2006; Elwood, 2006). Use of technology such as GPS and desktop computers gives power and authority to researchers (McCall and Dunn, 2012). Literature also shows that there are tensions regarding knowledge gathered through the PGIS process, for example local knowledge generated during the participatory process is not often recognized and applied during policy and adaptation planning (Cannon et al., 2003; van Aalst et al., 2008)

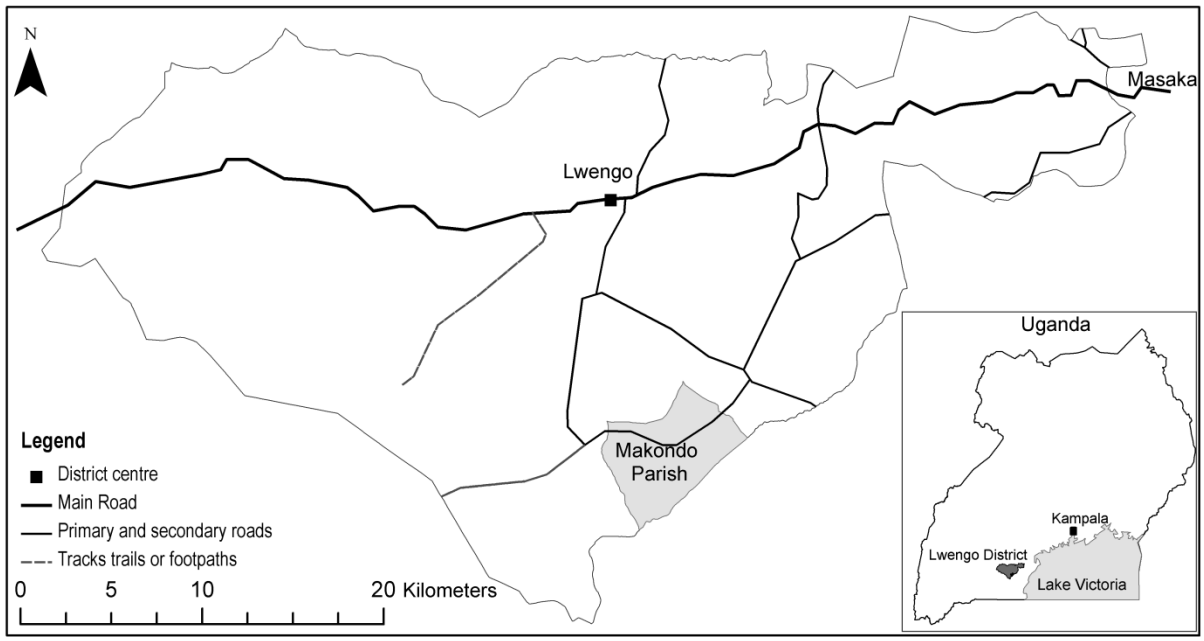
Given these tensions, the task for a researcher is to construct a process that can enable individuals (or communities/organisations) to play a strong or even central role in data collection and analysis, as well as the selection of frameworks, tools, and implementation. PGIS presents

scope to pursue a dynamic, context-sensitive methodology that promotes participation and knowledge integration. PGIS can be instrumental in translating and contextualising results from research with communities, such as those reliant on interactions with natural resources (Chambers, 1994; Chambers, 2006). It can facilitate multiple modes of data gathering and analysis. But such outcomes are by no means inevitable.

3.3 Study area and selection

This research is part of a larger inter-disciplinary project which has a field site in Makondo Parish in Lwengo District (Figure 3.1). In the study area, I asked 'how can we understand existing and emergent adaptive capacities to cope with climate change?' The purpose was to examine practices and relations during dry periods with the general idea of trying to understand how current practices might inform what households and individuals will do in future, possibly more intense dry periods. Thus, I inquired about the sorts of adjustments that occur; relations that emerge or indeed fade away; how the inevitable tensions associated with a dwindling resource are negotiated; and what do people anticipate happening in extreme events, as the climate models predict will occur?

Figure 3. 1: Makondo and Lwengo District, Uganda

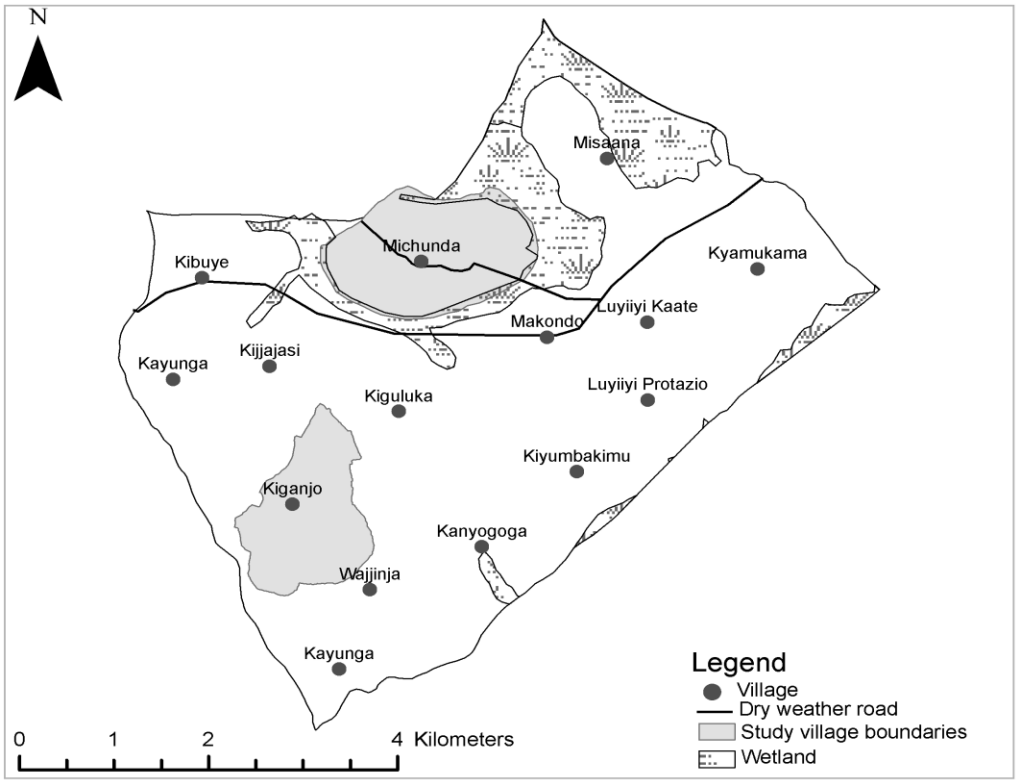


These questions were investigated in two villages, namely Michunda and Kiganjo (Figure 3.2). The main livelihoods in Michunda and Kiganjo are subsistence agriculture, particularly bananas, maize, beans, sweet potato and cassava. Households also grow on a small scale some cash crops such as coffee, tomato, and green pepper. Michunda, which has a population of 660 people, has some modern amenities such as a small health centre, two primary schools (one public and one private), a senior secondary school, and a gravel district feeder road. Some of the houses have electricity and rainwater harvesting tanks on their roofs. There are four shallow wells in the village, five open wells, and one borehole, although one of the shallow wells and then the borehole is only accessed by a mission station. None of the three other shallow wells are functioning. Michunda is a prominent village in the wider district because it is the base for some faith-based and other development NGOs. Almost 10% of the adults have paid employment and many of those jobs are directly dependent on the village's relations with the NGO sector. There

is wealth in the village, evidenced by some car ownership and small, quite vibrant businesses (ranging from hostels to butchers and grocers).

In contrast to Michunda, Kiganjo (population 550 people) has no school, no rural health centre, and no district feeder road. None of the households are connected to the electricity grid, nor do any households have solar panels. The village is noticeably much poorer than Michunda. There are two improved sources of water in the village – one shallow well and one borehole and numerous other unimproved sources – but both of the improved sources are non-functional. Households therefore use unimproved water for drinking, albeit usually with wild basil (Ocimum suava wild). Water-borne diseases are commonplace.

Figure 3. 2: Kiganjo and Michunda villages, Makondo Parish



3.4 Using PGIS to study adaptive capacity in Makondo

There have not been any attempts to understand adaptive capacity using PGIS, although there have been some applications of GIS regarding climate change assessment, for example modelling of index maps to assess national adaptive capacity (O'Brien et al., 2004; Sietchiping, 2006). There is a gap, therefore, which my research seeks to fill. My aim has been to explore the potential of using ethnography and PGIS to understand the adaptive capacity of people in Makondo to cope with climate change in general but with a particular focus on how people might manage longer dry periods. Setting up and implementing the dynamic assessment approach in the study sites involved several stages such as community entry and developing rapport, augmenting the existing GIS data, identifying the study boundaries and water resources as conceptualized by the communities and training community co-investigators. In the research discussed in this dissertation, a variety of techniques were used to elicit data.

The data collection for this research was based on a wide range of methodologies, as outlined in Table 3.1. In summary, my research entailed a mixed methods approach with a focus on PGIS and ethnography but also including other methodologies where appropriate. I have artificially isolated the methods outlined (Table 3.1) for data collection for purposes of description and discussion. In practice, these methods complemented and compensated for each other.

Table 3.1: Different methods deployed in dynamic assessment

Method	**Method of data collection**	**Data type**	**Data gathering period**	**Time extent**	**Quantitative density**
Participant observation	- Walks in the village and observations - Field notes - Audio recorder -Discussions - Camera	- Patterns of water access across seasons - Use of water space and time - Determinants of actions, when, why and how? - Livelihood means - Daily life involving water - Adapting with enclosure on the ground (cattle keeping and water) - Connections between communities and external actors (NGOs, private actors and government)	February-August 2011	Contemporary issues	Haphazard and more frequently
Informal and Semi-structured interviews	- Field notes - Audio recorder - Camera	- Adaptive capacity change over time - Livelihoods - Climate change overtime - Water variation perception and water management - Role of NGOs,	February-August 2011	Contemporary issues	70 interviews

Method	Method of data collection	Data type	Data gathering period	Time extent	Quantitative density
		private actors and government			
Group discussions	- Audio recorder - Field notes - Camera	- Typology of water variations - Livelihoods change analysis - Role of NGOs, private sector and government	March-July 2011	Past 10 years and contemporary issues	20 discussion
Key informant interviews	- Audio recorder - Field notes	- Historical resource management Socio-cultural and policy issues - Local climate change events NGOs and government staff	February-August 2011	Past 1930 and contemporary issues	10 agro-pastoralists 5 local government staff 3 NGO staff 10 community members
Participatory diagramming	- Sketch maps - Field notes - Discussions	- settlement pattern, access routes, social-economic activities and water sources - Local climate change events and seasonal activities	May-June 2011	Current issues	2 complete village mapping
GPS-assisted mental mapping	-GPS - Audio recorder - Walks in the village and out - informal discussion - observations	- Mental mapping, footpaths, grazing places, water sources, houses and institutions - Land uses	February-August 2011	Current issues	5 agro-pastoralists 2 complete village mapping
Community workshop	- Presentations - Breakaway group discussions - Plenary discussions	- Exploring knowledge fusion (local and scientific) - Dissemination	July 2011	Contemporary and current issues	1 workshop

Method	Method of data collection	Data type	Data gathering period	Time extent	Quantitative density
	- Audio recorder - Camera	of PGIS outputs to extra-local actors			
Questionnaire survey	-Questionnaire - Interview	- Livelihoods actions - Changes overtime - Climate change perceptions - Water manageability across seasons	June-July 2011	Past 10 years and contemporary	63 households in Kiganjo village 77 households in Michunda village

I lived in the study villages during the 2011 January-February dry season, the March-May rainy season and the June-August dry season, spending seven months in total. I conducted ethnographic research including participant observation with individuals and households as they used and managed their water resources; semi-structured interviews with respondents in both villages regarding water governance, conflict, and adaptive strategies; and I administered a short household questionnaire survey conducted at the peak of the dry season (mid-June to July 2011). This survey of a total of 63 households in Kiganjo and 77 households in Michunda covered livelihood activities, water variation during the dry season and the wet season, its manageability within seasons, and coping mechanisms and limits. Respondents to the questionnaire were selected based on purposive sampling (Patton, 2002) because this approach builds on the researcher's knowledge of a study population gained via ethnographic techniques and other methods. In addition, another part of the research entailed the use of 'participatory geographical information systems' (PGIS).

PGIS provides an approach to understand micro-scale adjustments, movements, and reactions by asking respondents to describe practices whilst using spatial technologies with the researcher (e.g. see Corbett and Rambaldi, 2009; Elwood and Cope, 2010). This approach shines a light on what people are doing in their daily lives beyond what they might say they do in response to a survey. The methodology promotes participation, which resolves the question of adult literacy rates in Sub-Saharan Africa; literacy rates are the lowest in the world (UNDP, 2011). This combination of iterative methods sought to capture what people do to alter their relations with their environment (Limb and Dwyer, 2001; Fetterman, 2010). I briefly discuss each method in turn in sub-sections 3.3.1 to 3.3.7:

3.4.1 Participatory diagramming

I used participatory diagramming in order to learn and understand where community water sources were, their settlement pattern and population, access routes, and social-economic activities in the study villages. My purpose behind the participatory diagramming was to leverage its benefits such as its ability to enable a researcher to work with 'hard-to-reach groups' in inclusive ways (Kesby et al., 2005). The idea behind participatory diagramming is that the process can help 'hard-to-reach groups' explore, examine, and clarify their own views of place and space in ways that would be less easily accessible to the researcher through traditional survey questionnaires. Also, participatory diagrammes can both generate rich insights and data that form the basis for subsequent examinations during discussion. Specific aspects of this research included:

- Consultation with research communities and participants. The local leaders were first consulted for three months (between February and end-April 2011). Frequent meetings were arranged to clarify my research and resolve some of the ethical, political and practical issues of my whole field work. In addition, consultation helped me to suggest materials we might use, also while they suggested what they might use and how.
- We jointly came up with a flexible working plan. The village leader was responsible for calling a mapping meeting.
- Regarding diagramming, two techniques were used: First, village mapping was conducted over two days during first week of May 2011 (almost three hours per day). On 1st May the participants used sticks to draw the village mental map. Initial drawn features stimulated the telling of their own stories about their village, village life, gender relationships, connections within and outside the village and environmental issues in their villages. At the end, the ground map was transferred onto a flip chart. On 8th May we then used a paper map to discuss jointly and make meaning from it. Features on the maps stimulated discussions that generated more data, such as where some water sources were located. In addition, some community linkages with extra-local actors started to emerge which was developed further during GPS-assisted mental mapping. Secondly, also on 8th May I introduced the idea of seasonal and rainfall mapping. I asked the following questions: what is the community's typology of rainfall and water events? What changes to water availability do people perceive? How do people respond to seasonal water variations? How do people respond to water scarcity by adjusting their livelihoods? This activity lasted longer (almost two months) because later on it involved key informant

interviews with elderly citizens of the study communities. I used the seasonal mapping because of its potential to support participatory debate, analysis and consensus of data and information that is socially and culturally constructed. Its emphasis on visual aspects made it a suitable tool for understanding adaptive capacity of the community.

From the drawings I isolated issues for further follow up in the subsequent methods. In particular, I paid more attention to water sources in my two study villages. I asked community members who turned up to indicate where their water sources were.

Participatory diagramming made an enormous contribution to the participatory data gathering in my research, but the approach I adopted did entail some problems. Participatory diagramming outputs are liable to distortion and they can trivialise spatial reality because they present arrangements of materials (such as water sources and houses and boundaries), not processes; indeed flows and relations can be difficult to represent in sketch maps. They can partly describe the resources by location but not explain how they are experienced by individual respondents. I found that spatial diagramming can be a useful tool to examine issues but cannot fully provide understanding (see, Chapter Six method section). The outputs of participatory diagramming are excellent answers to the descriptive 'what?', 'when?', 'who?', and 'where?' questions, but not so useful for answering the more analytical 'why?' questions.

Because the sense of place associated with particular water sources or localities and by particular gender groups of people in participatory mapping is qualitative, it may not be reducible to the Euclidean space of a map legend, as used in my dissertation. I observed during the community

workshop that the maps that were presented concealed some critical information such as congestion problem at water sources mentioned by women (see, Chapter Four sub-section on workshop). Hence the approach was not able to build fully on individual and community knowledge. In Chapter Seven, I have reflected on PGIS and ethnography tensions and multi-disciplinary nature of my dynamic assess that includes participatory diagramming.

3.4.2 GPS-assisted mental mapping

'GPS-assisted mental mapping' draws on all the methods and techniques discussed above such as participant observation, informal and semi-structured interviews, group discussions, key informant interviews and questionnaire surveys. The application of GPS-assisted mental mapping is an improvement on 'participatory diagramming' described by (Kesby et al., 2005). Although GPS-assisted mental mapping has similarities with other participatory (qualitative) techniques such focus groups, and semi-structured interviewing, in that they are interactive and tend to be group activities, there were some significant differences. Firstly, in GPS-assisted mental mapping my focus was both on narrative response to the question and its relationship to place. GPS inserts into the response the visual means and geographical location of addressing the question and suggests dynamic interviewing that involves not sitting back in a chair but rather walking out to places and observing practice and actions at individual scales. Secondly, walking with a GPS facilitates less eloquent individuals in the community to contribute and participate productively during the research. Thirdly, by walking to a place of significance with a respondent, GPS-assisted mental mapping went some of the way towards addressing the challenges many people might encounter during a face-to-face verbal interview or the actual drawing of a map or a symbol on the ground/paper. For example, seeing the feature told part of

the story regarding adaptive capacity. I found that 'GPS-assisted mental mapping' was found a good substitute for traditional PRA tools such as transects walks, and participatory diagramming; its data also integrated well with desktop GIS. My choice was also in line with contemporary debates in ethnography with regards the application of technology.

Having said all this, there were some limitations of doing work like this in places such as Kiganjo or Michunda. Most basically, PGIS needs a basic infrastructure, such as electricity and internet connectivity that may not always be available. Internet access and power are crucial when running desktop GIS but both of these were 3.5km away from the village and the latter unreliable; there were frequent power interruptions some lasting for more than 72 hours. Consequently, I depended on my back-up laptop battery that could supply power for maximum of 3 hours. This limited the way communities could participate during desktop map visualization and re-interpretation. In contrast, the hand-held GPS units were found to be user-friendly tool because they worked off dry cell batteries. In terms of technological barriers, as noted by Elwood (2006), even at the micro-scale a digital divide can be a major hindrance with regards to PGIS meeting the expectations of a researcher. Although some scholars (e.g. Chambers, 2006), indicate that the use of PGIS on the ground has increased local knowledge and understanding of associated technologies, I learnt that there are frequently individuals who have not encountered the technology before. This was illustrated in my research where some local people likened the hand-held GPS to a mobile phone; despite my protestations to the contrary they often called it *essimu* – mobile phone. In addition, they did not understand other survey equipments such as the laptop I was using. I overcame some of these problems by training three community members on

use of GPS and cameras but I did not succeed with the laptop which they said was too complex. They found GPS easy to learn and use because it was user-friendly, like the mobile phones which a few of them owned. This issue obviously means that research of this nature is rarely as fully participatory as a researcher might like. Finally, partly as a result of limited understanding but also justifiably given their experiences, research of this sort raised anxieties and made people feel uneasy. In my work I learnt that data collection at household level is perceived as intrusive and that there are frequently understandable anxieties about how collected data will be used afterwards. I observed some resistance regarding the use of GPS and cameras to map and photograph people's resources within their homestead; people felt uneasy with GPS because they thought it would record their assets, particularly land. In Kiganjo people feared that I was spying to buy some land offered to me by landlords who have a tendency to sell land without warning to a sitting tenant. This anxiety is heightened where unfamiliar technology is employed. In order to allay these anxieties, I had to assure villagers of proper protection and we endeavoured to agree on rules of engagement which we set together. These varied from household to household. Rules in my work included concerns for privacy of individual land holdings sizes and 'private' adaptive capacities such as location of beehives. Such data was deleted from the GPS by community co-investigators. Likewise, the villagers wanted to be involved and to follow how the data would be used after the study. We arranged periodic laptop visualisation of maps multiple interpretation. This process of community visualisation helped to validate data and get villagers' approval before the maps were printed, especially for the workshop.

3.4.3 Participant observation

The method of participant observation requires that researchers simultaneously observe and participate as much as possible in the social action under investigation with the aim of documenting the reality on the ground (Moeran, 2006; Watson and Till, 2010). Moeran (2006) argues that the reason for conducting participant observation is that by participating actively in the social action and actively getting involved in the interactions as they unfold, the researcher can come closer to experiencing and understanding the *insider's* point of view. Fatterman (2010) argues that effective participant observation means that participants should be willing, and able, to participate for long enough. Good participant observation requires a selfconscious balance between intimacy with, and distance from, the research participants (Fatterman, 2010: 37). By definition, as a participant observer I purposely placed myself in a series of very awkward social spaces, some of which are more difficult to describe than others. Participant observation requires a researcher to use his social self as his primary research tool (Fetterman, 2010: 34).

Being a participant in my study community provided me access to everyday life from the stand point of the 'insider', the people of Kiganjo and Michunda villages, as well as the agro-pastoralists of Makondo Parish. I used the methodology to gain entry into the study communities from early February and until early August 2011. I used the methodology to observe and experience the meanings and interactions of people and places from the role of the insider. My involvement with these 'insiders' helped me experience their world without 'staging'. For example, I went on random walks in the villages during the dry and the wet season. I also sat with people in their households and discussed how they used water. I gathered a lot of data

through such informal conversations. The methodology helped me perform multiple roles during the fieldwork. Having lived in the study community for seven months, participants became quite comfortable in explaining their daily practices, even at times inviting me to take part in their daily activities, such as traditional rainwater harvesting and laundering. I kept a dairy of these activities but I also recorded some audio clips, took pictures and stored locations in my hand-held GPS.

Although I found that participant observations a rewarding method in terms of uncovering, revealing, and exposing the web of complexities that generate an understanding of adaptive capacity (see, finding Chapters), the method is extremely challenging (Moeran, 2006; Watson and Till, 2010). During participant observation I strived to retain enough intellectual distance to ensure that I am able to undertake a critical analysis of the events, as well as maintain a relativist position as a researcher. This struggle characterised my position as a participant observer. I was aware that I was engaging in multiple relationships with people and extra-local actors but also that I should be ready, and able, to take a step back from these relationships. However, this was not always easy to do in practice because of the emotions involved. In many instances I failed to see with the eyes of an *outsider* as well as the eyes of an *insider*, although both views are only always partial. I was eventually able to recognize, however, that my "failure" to develop on-going friendships with my research participants was symptomatic of the values that characterized my approach.

3.4.4 Group discussions

A group discussion is a qualitative data collection method in which researchers and several participants meet as a group to discuss a given research topic. Limb and Dwyer (2001) argue that a group discussion method yields data and insights that are potentially less accessible without interaction found in a group setting. "Group discussions facilitate group members to listen to each other's spoken experiences that stimulates memories, ideas, and experiences in group members. Group discussion is an approach used by researchers examining the way in which group participants in conjunction with one another construe the general topics under investigation" (Brayman, 2004: 346). Focus groups are especially effective for capturing information about social norms and the variety of opinions or views within a population, and from a diverse range of people (Delyser et al., 2010). The strength of group discussions relies on allowing the group participants to agree or disagree with each other so that the process of argumentation provides an insight into how a group thinks about an issue under discussion (Limb and Dwyer, 2001). The outputs are always a range of opinion and ideas, inconsistencies and variation that exist in a group in terms of their experiences and practices regarding real issue on the ground.

Since a group discussion method gathers together people from similar backgrounds or experiences to discuss a specific topic of interest such as water management and seasonal changes, I drew upon this to select group participants. I used focused group discussions to explore the meanings of survey findings that cannot be explained statistically, the range of opinions on a topic of interest and to collect a wide variety of local understanding of water

governance and grazing practice. In bridging research and policy, this approach can be useful in providing an insight into different opinions among different parties involved in the shaping adaptive capacity at the micro-scale. It is also a useful method to employ before designing questionnaires. Building upon the richness of focus group data to gain insights and understanding on issues that emerged from my observations, participatory diagramming, GPS-assisted mental mapping. I used the group discussions as a method to create a complete picture of how a given issue affects a community of people in groups of between six and 12 participants to discuss issues lasting 60-120 minutes. For instance, what problems people faced during the drought years 2000? Where did they collect water? How did you draw water at home, and Why? How did they organise themselves? What support did they get from extra-local actors? During focus groups, there were a broad range of contributions to these issues, and broad understanding by providing well-grounded data on social and cultural norms, the differential impact of drought within the community, existing opportunities and limits of dealing with extra-local actors, and people's opinions about their water sources and livelihood. My data consisted of recordings, transcripts of those recordings, flip charts from the discussion, and notes from the reflection session held after the focus group. After data collection, I expanded all handwritten notes and expanded into more complete narratives, then entered into my laptop.

Group discussions, however, present some challenges. They are heavily shaped by by social dynamics among the participants. I needed to be alert to reactions and sometimes manage them, for example by drawing on less eloquent or silent participants. In some instances I observed that village leaders and their wives could dominate discussions, while other group members remained

passive. Handling of sensitive issues such as ‘bad practices’ by village leaders (see, Chapter Four) and NGO conduct (see, Chapter Five) proved complex in group discussions because of the manner in which some of the people reacted. I found that conducting group discussions can be complex and demanding to an individual researcher to resolve verbal and gestures or facial expressions from group participants. This proved more challenging when conducting discussions in institutional setting involving frontline staff members in institutions such as NGOs’ where much of the decision-making is taken out of their control. For example, asking 'why do you withdraw project support while communities are still vulnerable?' I found it difficult to get a direct answer. The other limitation was choice of the venue and time to suit all group members without loss of time and earnings from their livelihood activities. Although all group discussions were held in the village, I met some challenges regarding group meeting time. This time problem is a challenge because typically household level domestic chores and farming activities are time demanding on part of women (who are often busy all day long). Women therefore often reported late for group discussions. I also found it challenging to manage the running time for group discussions of a normal focus group of between 60-90 minutes (Bloor et al., 2001).

3.4.5 Semi-structured interviews with key informants

Semi-structured interview refers to a context in which the interviewer has a series of questions that are in the general form of an interview guide but is able to vary the sequence of questions (Bryman, 2004). During interviews, a researcher has a list of fairly specific topic to be covered, but the interviewee has a great deal of leeway in how to reply. The questions are frequently asked somewhat more general in their frame of reference from that typically found in a

structured interview schedule, and the interviewer is not expected to follow on exactly in the way outlined on schedule. In addition, "the interviewer usually has some latitude to ask further questions in response to what is seen as significant replies. Interviews of this nature can be informal and the phrasing and sequencing of questions may vary from interview to interview" (Bryman, 2004: 113). The responses are usually audio-recorded and transcribed whenever possible after the interview.

In this thesis interviews (key informants, informal and semi-structured) were verbal and in the local language – *Luganda.* The questionnaire was also in the local language. The interviews generally served as a guideline, checklist, comparison or triangulation of responses and observations with regards the research community's beliefs and practices. During fieldwork, I used interviews at any time and randomly. For example, a list of questions about climate change variation and livelihood change was asked: what is changing in your cropping pattern? Why are these changes happening? Where are you water sources? How do you characterize them? Asking these questions helped to set the scene; however, follow up interviews (methods) tended to shape in order to reach meaning regarding my research objectives. Semi-structured interviews were central because they examined critical issues about the researched communities. These interviews shaped my focus and urged me to conform to the researched community's view of climate change, water management and their connections (see Chapters Four, Five and Six).

Informal interviews, used in this dissertation, were casual conversations which allowed participants to relax. Nevertheless, I designed them to enable a joint understanding of adaptive

capacity. I adopted informal interviews in order to gather an explanation and understanding of climate change and water management with a view to discovering what community members thought; I compared various responses in order to understand adaptive capacity. Such comparisons helped establish a shared understanding. Through these processes we were able to consolidate rapport. Crucially, most of the informal interviews were GPS-assisted as they were conducted during the walk in and out the study villages.

As a result of the various interviews, field notes and transcripts emerged as did data on specific locations and places within and beyond the villages. For example, some interviews though focused on water governance at home included information about places and journeys to fetch water. Other scholars have coupled geo-spatial tools (GIS) and ethnography, geography and space-time studies (Kwan, 2002); there may differ from my work because this study depends exclusively of primary data generated at micro-scale.

As I have indicated in Table 3.1, I recorded 70 interviews between February and August 2011. I found it hard to handle a mountain of data yielded from audio-records on my mini-disk. Typing of these interviews took me longer time in the field than suggested in my proposal to transcribe each interview before the next interview. In Chapter Seven, I have discussed in details the challenges associated with data handling when using mixed methods (of PGIS and ethnography). I did not have access to a transcription software to make the task of transcription somewhat easier. I learnt that it is important to bear in mind that a researcher using mixed methods must allow sufficient time for transcription and be realistic about how many interviews he can be able

to transcribe in the field given the time available and amount of data generated by other methods (see, shortfalls of this dissertation in Chapter Seven). I argue that this is specifically crucial when applying 'dynamic assessment' in assessing adaptive capacity or any issue of interest at the micro-scale where things change so rapidly and dynamically connected.

3.4.6 Questionnaires

A questionnaire in my work is a typical form of interview in survey research and involves the administration of an interview schedule by the researcher (Fetterman, 2010). The aim of the structured questionnaire is for all research participants to be given exactly the same context of questioning. The approach gives each respondent exactly the same interview stimulus as any other to ensure that replies can be aggregated and this can be achieved reliably (Putton, 2002). The researcher or interviewee reads the questions exactly and in the same order as they are printed on the schedule. The questions are usually very specific and very often offer the interview a fixed range of answers.

My questionnaire was a product of my ethnographic knowledge about the study community. I used this tool to specifically test hypotheses about water governance at the micro-scale. Hence my brief questionnaire was referenced to specific case studies. The survey was completed between June and 30th July 2011. The questionnaire contained both open-ended and close-ended questions and administered through face-to-face interviews at a household level, targeting both male and female individuals aged 18 years and above. I then compared the results from the survey with my descriptive findings and GPS-assisted mental mapping.

At the end of my study I conducted a small household (or individual) survey with participants in Makondo Parish, specifically Kiganjo and Michunda villages, and agro-pastoralists. I used the questionnaire to explore specific concerns, such as how many household practice household water recycling? How many water storage containers do each household? What activities are dropped first when water is scarce? How do they cope with water scarcity? The questionnaire helped me to explore these issues and other issues in details and get a good grasp how many household are practicing a particular adaptive action.

While the questionnaire survey is used in my study, certain problems are identified. I found that the method was extractive. It obtained information from the respondents and gave nothing in return because I was avoiding too much rapport that can potentially bias respondents' answers. I observed lack of shared meaning with my respondents, for example, understanding of climate change and hence implying different things in use of term 'climate change'. This challenge influenced some respondents consistently to agree or disagree with a set of questions which is a reflection of low morale or commitment on part of respondents during the interviews.

3.4.7 A 'community workshop'

The community workshop was conducted July 21, 2011. The workshop was organised for the community to communicate their findings from the research, but also to gain input from extra-local actors on the issues raised in the research. The workshop was also aimed to enable me to gain an understanding of relations around water between extra-local actors and representatives from the community. I called on my 'gate keepers' (village chairpersons) to mobilise the

community members to attend the workshop, plan the workshop agenda together, and also we agreed to use Luganda as the main language. Village leaders from Kiganjo and Michunda extended invitations to others from their villages, including local councillors, sub-county councillors, the District Water Officer, the District Health and Environmental Officer, the District Hand Pump Mechanic Supervisor, local hand pump mechanics, local NGOs management team members, political party leaders, and minority groups such as agro-pastoralists. The workshop was useful in the sense that technical experts, political leaders and community members together refined, cross-checked and validated data we had generated. The workshop had three sessions. First, there was the plenary session in the morning for the entire workshop during which outcomes of the research were presented by the case study communities. Next, during the first afternoon session, representatives from each group broke into small discussion groups to discuss issues that were raised from the community presentations, for instance what services are made available by extra-local actors to enable households cope with climate change, especially water? What role can PGIS play in water management? How can functionality of boreholes and shallow wells be improved? What are the challenges facing effective networking? Finally, before the workshop ended, a plenary session was conducted, and representatives from each discussion group presented their issues in plenary workshop, inputs from workshop were considered. This allowed extra-local actor to gain new insights about the micro-scale water governance dynamic and adaptive capacity constraints.

The workshop raised numerous concerns. My post-hoc analysis of the workshop revealed tensions t between ‘scientific’ and ‘non-scientific’ sources of information. I observed this during

the introductory remarks by workshop participants. Officials from local government and NGOs when they first spoke at this session criticized the villagers' lack of water management knowledge in their own areas. In addition, they assured the villagers that they would share their insights into water management during the workshop implying that their input would be superior to that of the villagers. This happened before villagers presented their PGIS maps and situation. However, by the end of the workshop the group activity had helped to break down barriers and had assisted in the releasing of new knowledge, as well as resources from the authorities. One decision-maker said:

> "One thing I liked about the workshop is that communities were given an opportunity to present the issues that emerged from the research in their respective villages. … Most importantly, the maps acted as a channel that can easily help communities to inform service providers where to improve. I will see to it that the [NGO] partners with district and sub-county officials on how to scale up the initiative because we have seen new elements that have awakened us to improve on service delivery" (Personal Interview, 27 July 2011).

The official's statement shows that PGIS can facilitate two-way communication that can have a positive effect. Furthermore, PGIS can promote inclusiveness that can lead to transformative engagement in which the participants strive to understand each other's perspectives and experiences. Other respondents noted that the workshop had facilitated knowledge exchange about adaptive capacity and that it encouraged capacity enhancement for both service providers and communities. I argue that when PGIS is used in the manner demonstrated in this research, it

can no longer be considered, as Elwood (2006) suggests as a tool for the extraction of information, and exclusion of grassroots from the decision-making.

In summary, although the community workshops proved to be a useful tool in dynamic assessment, certain problems associated with it are identified. The problems are not necessarily unique to the community workshop, in that they can be attributed to kindred method, such as group discussion and participatory diagramming. The issues of social and group dynamics, power differentials and gender bias characterized the workshop, for example, the District Water Officer, NGO officials and political leaders dominated the discussion at the start of the workshop. Women were given less opportunity to speak at the start. However, towards the end the situation improved after some moderation by the workshop facilitator.

3.5 Ethical consideration: reflexivity

In discussing the challenges faced during field research, I will focus three main challenges I encountered during my field research: anxieties among community members about my presence there; the multi-disciplinary nature of the Water is Life project; and working with an NGO with a poor reputation with researched community.

I encountered the challenge of integrating into a community that had anxieties about my presence. Many among my research community found it had to accept me. I knew that communities I researched had anxieties about me, but as an ethnographer I had no choice but to work towards improving my relationship with potential respondents. I began by talking with

village leaders with a view to trying to develop a good relationship with them. After the formative stage of my research, on 30 May, 2011, I was told by the village leader that the community thought I was a government agent sent to spy on their land and later on bring potential buyers if I did not buy it myself. I was told this in Kiganjo because in this village people belonged to an opposition party and did not trust the ruling party. Part of the problem was that the GPS and camera I always carried along with me made the people believe that I was measuring their land. There was also a group of community members that questioned why I had travelled from Malawi to ask them about water governance and climate change. I was often, asked, "is there no water in Malawi?" Distrust and scepticism about my agenda contributed to my position as an outsider.

Because of the forgoing constraints, I was forced to (re)negotiate the relationship on a continual basis. Some of my negotiation strategies were similar to Sultana (2007), which included attending some local functions such as wedding ceremonies, funeral functions, church and mosque functions. During these functions often times I engaged in conversations in the local dialect, Luganda. However, I remained conscious of my local language deficiencies and anxieties that existed about my research. Later on, though, my rapport improved and I developed a relation of trust with the community, specifically with village leaders who helped to connect me with the wider community. I am aware that I was only able to partially access the lives of the researched community members because of other unresolved anxieties people held about my research. The important thing for me is to be faithful to the relations and stories that were shared in this research.

The multi-disciplinary nature of the WIL project also presented challenges. All eight doctoral students conducting research in Makondo Parish were connected to the researched community via one local NGO. Such an intensive research project often overwhelmed the researched communities. The projects were broadly grouped into social science and engineering research. The former group did not install any equipment in the community while the later installed instruments such as rain gauges and hydrological equipment in Makondo. The differences in research approaches led communities to question what I brought for them. The engineers left an impression that all researchers that came in the villages had tangible material resources and have immediate solutions to their water problems. I was asked many times to help them locate a best site for open wells and shallow wells and design a solar system to pump water from wells to locations closer to their houses. These expectations were beyond my research and professional scope.

My research was also influenced by the internal politics of the place and overall politics of the project. In some instances, I encountered situations where both village leaders and key informants (extra-local actors) willingly discussed pit-falls of water governance, even to the extent of naming the individuals responsible for failures regarding water facilities. However, they declined to give an approval to document such information formally because of fear of risking their already fragile relations.

Finally, the tarnished reputation of the local NGO detracted my interacting with community. The coordinator of the NGO owned a guesthouse in the community which he operated as a brothel. I

was lodging at this guesthouse for seven months. The brothel was not a welcome business in the community, especially to married women; it was blamed by many for marriage problems and the spread of HIV/AIDS. Associating with the NGO complicated my research in many ways. The researched community were led to question where I lodged. I did not understand why I was questioned until a team of co-investigators told me more about the guesthouse. Although I told the researched community that I am not part of the NGO, they could not believe this because the seven other doctoral students identified themselves with the NGO and its key staff. Sadly, I failed to separate myself from the entire project team and the NGO because it was my gatekeeper.

In summary, I argue that the three challenges discussed above shaped my research. I know that the knowledge produced is influenced by the challenges I encountered. This dissertation is a partial representation of the data and materials I gathered in the study. I am aware that all these impact my final representation of materials as will be noted in the forthcoming chapters. I have concealed some information in an attempt to be as ethical as possible and true to the relations that occurred in the study community.

3.6 Summary

My aim in this chapter was to highlight methodological gaps in the provision of a basis for understanding adaptive capacity assessment, specifically in developing world contexts. Adaptive capacity is difficult to measure and quantify, hence the need for a ‘dynamic assessment’. This chapter outlined a variety of methods that were used to conduct such an assessment. My assessment is dynamic because it is participatory and ethnographic, looks at inter- and intra-

household governance mechanisms, and examines relations between the villages and extra-local actors. Generally, literature indicates that adaptive capacity is determined by a number of factors, including economic wealth, availability and access to technology, information and skills (information systems, training), institutions (e.g., inadequate institutions can limit adaptive capacity) and equity (e.g., access to resources) (IPCC, 2001). However, practically how these resources are mediated at the micro-scale seem to insufficiently addressed because most of the attention in water sector seem to focused at meso- and macro-scales (de Wit and Stankiewicz, 2006). Therefore, we can learn much from the two villages. The key point is that people in these villages do have capacities to adapt or deal with longer dry spells but that there are also serious constraints, forces that hold them back; however, it is also necessary to note that some households are inevitably better off than others, for example because they have assets that others do not, hence it is necessary to take those differences into consideration when we talk about adaptive capacities. The rest of the dissertation focuses on data I collected in two villages, Kiganjo and Michunda. My approach examines three interrelated aspects of adaptive capacity in those villages:

- What sorts of assets and adaptive practices exist in the villages?
- What sort of flexible governance mechanisms in the two villages exist?
- What evidence is there of scope for local and extra-local knowledge to fuse?

CHAPTER FOUR

APPLICATION OF DYNAMIC ASSESSMENT IN ASSESSING ADAPTIVE CAPACITY TO CLIMATE CHANGE: A CASE STUDY OF KIGANJO VILLAGE

4.1 Introduction

In the previous Chapter I discussed different types of participatory GIS, my choice of PGIS for my fieldwork, and the specific methods that were used to gather data for my dissertation. I have called my approach a 'dynamic assessment' of adaptive capacity. In this chapter, my focus is on how my choice of PGIS benefited the research. I outline how I combined PGIS with ethnographic methodologies and how this combination helped me to learn more about adaptive capacity. This chapter describes how villagers engaged in PGIS mapped their village. I discuss dilemmas that were encountered and explain how PGIS helped the communities access resources.

The backdrop to this Chapter is that many African communities relying on surface water stand to suffer if current climate change models become a reality and seasonal rains become more erratic, less frequent, or fail to arrive at all (IPCC, 2007). It is therefore necessary to understand what adaptive capacity might exist among Africa's rural communities and to explain if such communities can find ways of coping with longer dry periods. In this context their inclination to draw upon their historical experiences and the ways in which they could connect with outside

agents, such as institutions of local government, to improve their capacity to cope with climate change will also be examined.

This Chapter draws on research into adaptive capacity in Kiganjo Village, Makondo Parish in Lwengo District (see Figure 1.1). My research aimed to demonstrate the applicability and value of my 'dynamic assessment' approach. The following discussion introduces the case study and then identifies three ways that PGIS and ethnographic methods can be a viable and useful tool in assessing adaptive capacity. The conclusion summarizes the key findings and indicates what might be the broader significance of using PGIS approaches in other developing world contexts.

4.2 Case study and research design

Drawing from the limited but growing literature on adaptation to climate change in rural Africa, adaptive capacity at micro-scale involves different practices and actions of individuals and households, in part, but it also involves connections and relationships (e.g. Osbahr et al., 2008). In Chapter Two, the literature shows heterogeneity of adaptive actions between individuals and households with regards diversification of asset stocks and the influence of extra-local actors. Understanding household and village practices that influence adaptive capacities requires context-sensitive grounded observations with participation of the local people. However, the previous chapter shows that dominant methodological approach in the literature on adaptive capacity in Sub-Saharan Africa relies on surveys as opposed to long-term observations at a micro-scale. There are dangers, for example, if participatory methodologies are not sufficiently valued by researchers, to miss micro adaptive actions and practices people depend upon (van Aalst et al., 2008). Thus, with regards to understanding adaptive capacity in Sub-Saharan Africa,

there is a need for methodologies that are sufficiently grounded, rigorous but also deeply participatory.

Building on the grounded methodological approach (e.g. West et al., 2008) and the potential application of GPS alongside ethnographic methodologies (e.g. Nielsen and Reenberg, 2010) to reveal and document adaptive actions and practices in Africa, I used dynamic assessment to explore adaptive capacity at micro-scale. PGIS combined with ethnographic methodologies is sufficiently grounded, rigorous but also deeply participatory (see Chapter Three).

The enhanced PGIS used in my study emphasizes a more collaborative process regarding the development of spatial data. It seeks to include people's perceptions of spaces and places in a way that can deepen the researcher's knowledge of specific empirical issues. PGIS seek to enrich the study with qualitative data that is rich in contextual detail they provide about social and material situations. PGIS ensures that, instead of mapping and labeling the villagers as passive victims of climate change, their knowledge, capabilities, creativity and agency to make decisions in the face of climatic and other stresses can be captured and used to help secure their livelihoods. Ethnographic interviews in this study, for example, elicit responses from interviews and observations that describe the condition, relationship and processes in depth. My research draws not only the qualitative data details such as description of material change generated by the combination of PGIS and ethnography, but also offer interpretation impacts of change or meaning and I use them to understand negotiated knowledge. That is, the location of water

source and its different meanings among villagers to get deep insights into social and political situation of Kiganjo.

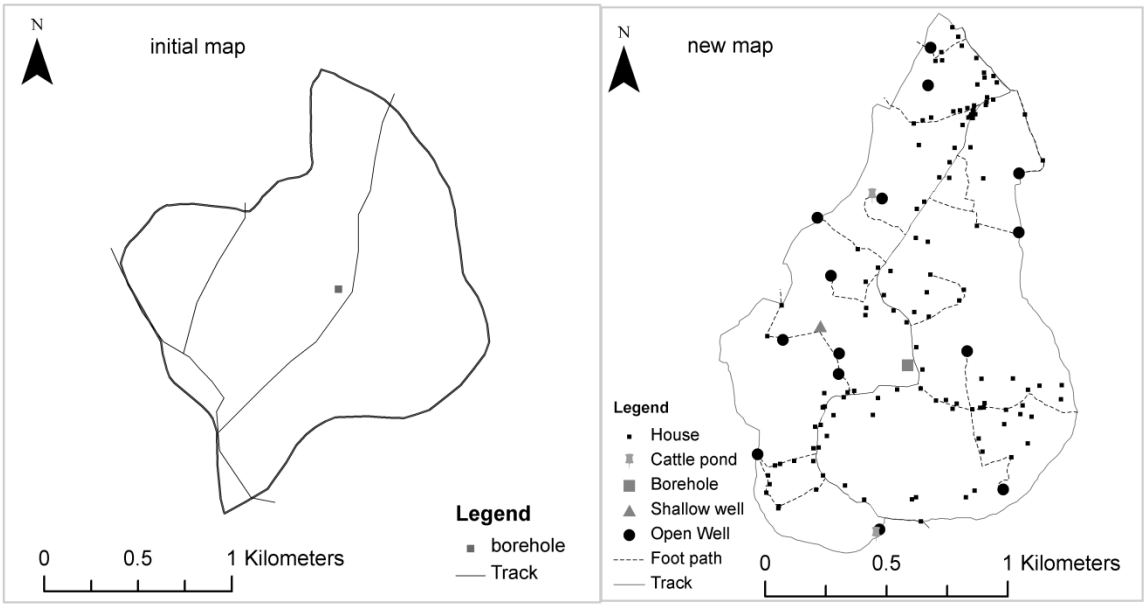
My research used a dynamic assessment to help reveal elements of their adaptive capacity to climate change. But I also aimed to assist the communities to communicate their situations to extra-local decision-makers and examine possibility of fusion of what local people know and do and what extra-local deliver to enable communities to cope with water variations. The latter point is important because, as scholars have noted recently, understanding adaptive capacity entails asking villagers what they do, but also paying attention to how they interact with external actors. Literature shows that what individuals communities know and do are platforms on which external adaptive strategies can build upon (Kansiime, 2012).

Although I studied two villages in Makondo, this section reports on my activities in just one of them, Kiganjo. The main livelihood in Kiganjo is subsistence agriculture (see Chapter One). The village has no school, rural health centre, or district feeder road. None of the households are connected to the electricity grid.

My work occurred in three stages. The first, a formative and exploratory stage, lasted six weeks. I worked in all fifteen villages in Makondo Parish with a view to identifying the specific places in which the remainder of the work would occur. I wanted to learn about local understandings of domestic water management in particular, but also how their communities function. I collected data from interviews and direct observational analyses and began building a GIS database of the

parish. I then selected Kiganjo village for more detailed work because, unlike most of the other villages, it had been bypassed by NGOs since at least 2001. I used data from the Ugandan government GIS laboratory to produce my first map of the village (see Figure 4.1), which looked strikingly empty and which I later found did not reflect the village's boundaries.

Figure 4.1: Two maps of Kiganjo



In the second stage, I began the work of eliciting information that would allow me to understand adaptive capacity in Kiganjo. I first engaged community leaders to plan the research that I aimed to conduct. This was necessary to ensure my fieldwork ran smoothly and to confirm that the people in the study were as comfortable with, and accepting of, the methodologies as possible. To this end, we agreed that I would be able to work with villagers to use hand-held GPS units, digital cameras, and a digital audio recorder. The community chose three members to work as unpaid co-investigators during the research period. I trained them to use the hand-held GPS units

and digital cameras. Alongside this work, I also conducted 70 informal interviews with people in the village. We held regular meetings at village-level to discuss emerging findings and by the end of the period we had collaboratively constructed a rich GIS database drawing on the new data villagers had collected.

In the third and final stage of the research, I worked with the villagers to create a forum in which they could communicate knowledge about their adaptive capacity to decision makers from local government and other actors, particularly NGOs. The main outcome was a workshop in which community members, including many of those lacking literacy, could speak and listen to councillors, planners, and other officials with decision making powers. Following on from the workshop, as Elwood (2006) recommends, I conducted open-ended and semi-structured interviews with workshop participants with a view to understanding the potential continuing benefit of research to the participants.

4.3 The application and benefits of PGIS in assessing adaptive capacity

4.3.1 Uncovering water sources and connections

The first way in which PGIS helped my research was in mapping the availability of water sources in the village. I asked villagers 'Where are your water resources?' In practice, this question is not as easy to answer as it might at first appear. As Coêlho et al. (2004) assert, research in drought-prone areas is a complex process because of the interaction of drought with climatic events, and economic, environmental, and political factors. In light of these complex interactions, I combined PGIS with ethnographic methodologies with a view to developing an

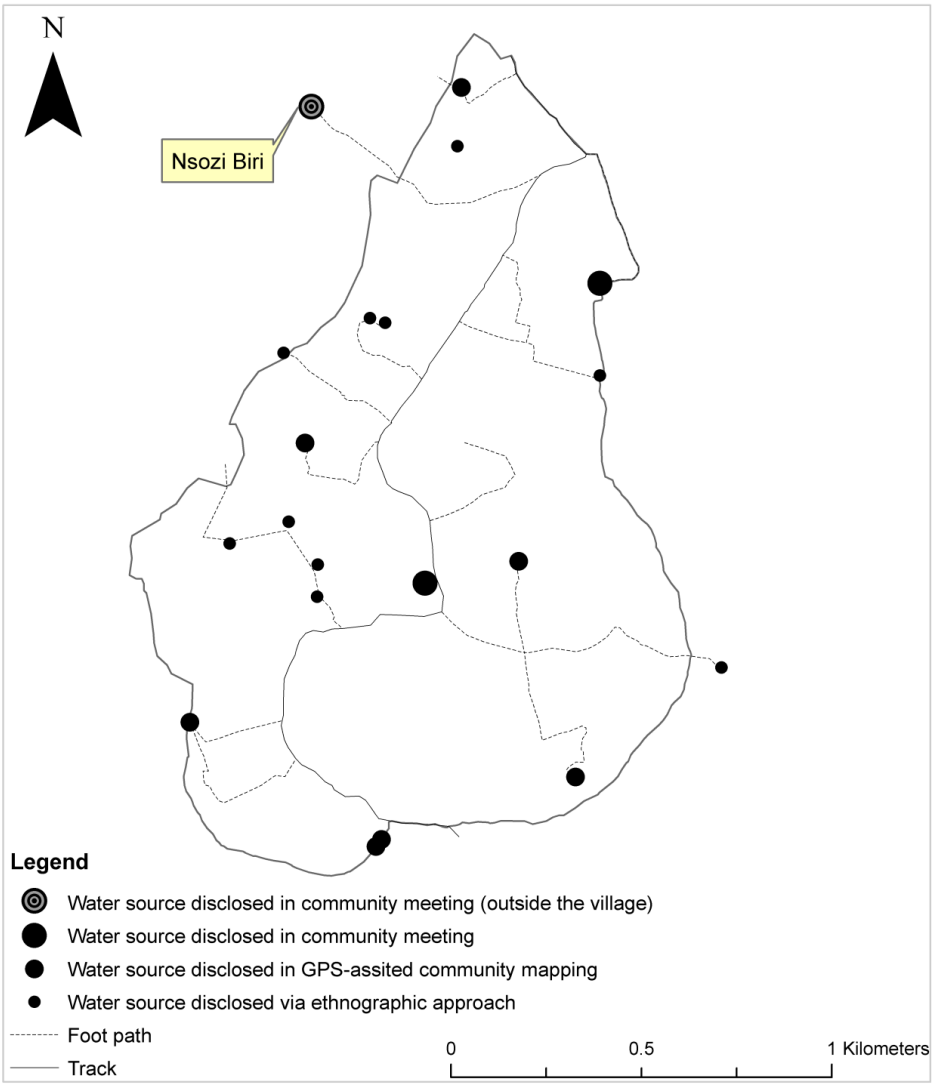
accurate answer to my question. In particular, I used 'GPS-assisted mental mapping', in which respondents carried hand-held GPS units while mapping and talking about their places within the village. Use of GPS-assisted mental mapping benefited my research in the following ways: firstly, regarding data quality, the GPS units drew the trails of the village boundaries, household boundaries, and of fixed locations such as water sources. Talks added insights into places and material situations which later allowed further examination social and political situations. In addition, it reduced paper work and intensive use of flip charts during field work; thirdly, some benefits of GPS-assisted mental mapping were potential to offset challenges of spatial data management that would have occurred if the same data was collected using PRA mapping (e.g. Mbile et al., 2003) and data loss after field work (e.g. Cannon et al., 2003). Firstly, using the units also increased the reliability of data and reduced both time and labour requirements that would have been involved in such an effort using less sophisticated techniques. Secondly, the use of the technologies relaxed the respondents because they did not need to draw, or even use pen and paper, thus overcoming illiteracy and communication challenges.

Figure 4.2 maps where the water resources of Kiganjo village are located and the order in which respondents revealed them to me. The order reflected how significant the villagers perceived each type of water source to be. The first that were disclosed were dependable sources available to all villagers; the second were seasonal sources not accessible to all; and the third belonged to minority groups such as agro-pastoralists. This information provided ethnographic depth and enabled an interpretation of the significance of each location and resource to life in Kiganjo. For example, from my initial interviews and discussions with villagers, I was led to believe there

were just three water sources in the village. Yet, seven further sources were revealed after I engaged community members in participatory village mapping *and* an additional ten water sources were revealed after I used GPS-assisted mental mapping at a household level, including water sources revealed agro-pastoralists, brick-makers and small irrigation farmers.

In total, then, twenty water sources were revealed, a result which paints a very different picture from the initial sense of life in Kiganjo. In the process of constructing this richer and more detailed map of Kiganjo's water sources, my combination of PGIS and ethnography generated further insights associated with the range of connections between each source and people and organizations outside the village e.g. the fact that, during extended dry periods, the people of Kiganjo have used a well in a nearby village. In this sense, adaptive capacity in Kiganjo overlaps with and draws upon a wider geography of relations. In my view, understanding precisely what those relations are is critical when trying to assess adaptive capacity at the village scale; surveys alone risk missing this sort of insight.

Figure 4. 2: Water sources disclosed during the research in Kiganjo



Most of the water sources, 16 of the 20 researched, are seasonal open wells within the village and 1 open well[6], Nsozi Biri, outside the village. Two improved water sources, a borehole and

[6] An open well is a hand dug surface water source. It is regarded as unsafe source by Ugandan government (GoU, 2007b).

shallow well[7], are not functioning. Thus, safe water is relatively scarce in the village. Moreover, the available open wells vary in their uses considerably between domestic uses combined with irrigation, and those used solely for livestock or irrigation. Uses of open wells depend on the original purpose for the well, for instance, the Kyanamirira cattle pond (Figure 4.4) was dug for watering livestock in 1997 by the local councillor three (LC3); and this well is still mainly used by two cattle keepers living near it. Three other open wells were dug by cattle keepers in the 1960s and they are also still used predominantly for livestock, while the remaining wells are multipurpose.

The ethnographic data generation regarding water sources revealed that in Kiganjo there were different connections influencing access to water and other resources needed for coping at the micro-scale. For example, during the process of characterizing water sources I found that a range of connections exist at each source between people and organizations outside the village. These connections gave me indications to understand how people cope with dry periods.

One such period was in 2007/2008 when all of the water sources in Kiganjo dried up and people were forced to use the nearby Nsozi Biri open well. Because this well had such importance to the communities surrounding it, there were informal but vibrant institutions such as a 'caretaker committee' designed to protect it from abuse and to ensure that it continued to function. This caretaker committee is in addition to the defunct official water user committee which has a broad

[7] A borehole is engineered deep groundwater source, while shallow well is engineered but surface water source. Both of these water sources have hand pumps and regarded as safe water sources by the Ugandan government (GoU, 2007b).

mandate over water management in the village, specifically improved water sources such as borehole and shallow well (for detailed information on the mandates of water user committees see, the Ugandan Water Sector Policy, GoU, 1999). Further evidence gathered on the ground revealed that the caretaker committee and defunct water user committee were socially embedded and overlapped. For example, the village leader who is an ex-official on the water user committee played a leadership role on the 'caretaker committee' and coordinated with two other villages leaders from Kiterede and Kijjajasi villages.

Interactions between these two committees have shaped people's perceptions regarding water sources in Kiganjo. For instance, I was told that households claim ownership of specific water sources in the village: all open wells are identified by individuals' names dating back to 1930s. The various identifications of water sources shaped the ways in which the water sources were managed and accessed by the individuals and occupational groups. My observations and indeed responses from interviews revealed that the diverse perceptions that individuals held about specific water sources influenced their management, daily lives, practices and actions on the ground. I found that some families could not draw water from some specific open wells because of beliefs that they held from their ancestors, such as a story of boy who drowned in old Nsozi Biri and was never found. Since then, this family abandoned drawing water from this well until recently when a new Nsozi Biri opened in 2000 when some of the households from this family started collecting water from it. In addition, I found that past conflicts between families explained why some households do not share open wells, even if it was the nearest source of water to them.

Similarly, I found that the borehole was identified through a variety of names. Some called it the 'UNICEF borehole', while others referred to it as the 'government borehole'. During community meetings, I observed that people failed to agree on specific management options regarding a borehole because of the way they identified it. For instance, some of those who believed that the borehole was given to them by the government believed that the community should pay for its maintenance, while others regarded it as a 'free resource'. These differing views created tensions, which shaped the outcome of extra-household adaptive capacity. In interviews I held with some extra-local actors, such problems were noted to be quite common. One respondent said: "people do this because when we enter in any community to deliver a service we introduce ourselves as givers of water. That's why they know us by names and tie the name to the water source. Of course it is something we need to avoid..." (Personal Interview, 8 June 2011). This view was reinforced by the District Water Officer. But the officer noted other problems, for example, that most technologies are delivered in a hurry. In addition, the heterogeneity of actors' interests at any particular time can produce differences regarding reporting requirements and the definition of 'good' service (Personal Interview, 8 June 2011). Further observation on the ground revealed that that the formal 'water user committee' in Kiganjo was complemented by complex relations comprising of family and occupational groups which connected people in many ways at that time. These connections seemed to cross the boundary of the formal mandate. In one incident, for example, the village leader was alleged to be abusing power by favouring his family friends when it came to payment for water; a few of his friends, it was claimed, had not been

paying towards operation and maintenance of the borehole.[8] In one of the group discussions, one member contended that:

> *Community member*: "You village leader, you should stop favouring your friends. We know some people don't contribute at all that is why we are demoralised to pay our dues toward the borehole. Stop this first...."
>
> *Village leader*: "You're out of order".
>
> *Community member*: "No. We need to sort this thing first before we move forward…"
>
> *Village leader*: You're not supposed to make such as statement when visitors are here" (Personal Interview, 23 July, 2011).

This argument gave me further insight into the micro-scale dynamics of adaptive capacity. My survey also found that individuals in leadership, and households closer to the village leadership, were more articulate, more connected with extra-local actors, and better informed about water service delivery than the other villagers. The results of my research suggest that, though external interventions have a strong likelihood of enhancing adaptive capacity if properly delivered, they can also hinder adaptive capacity within a village as a whole if they tend to benefit a few households who have good access to extra-local actors at the micro-scale.

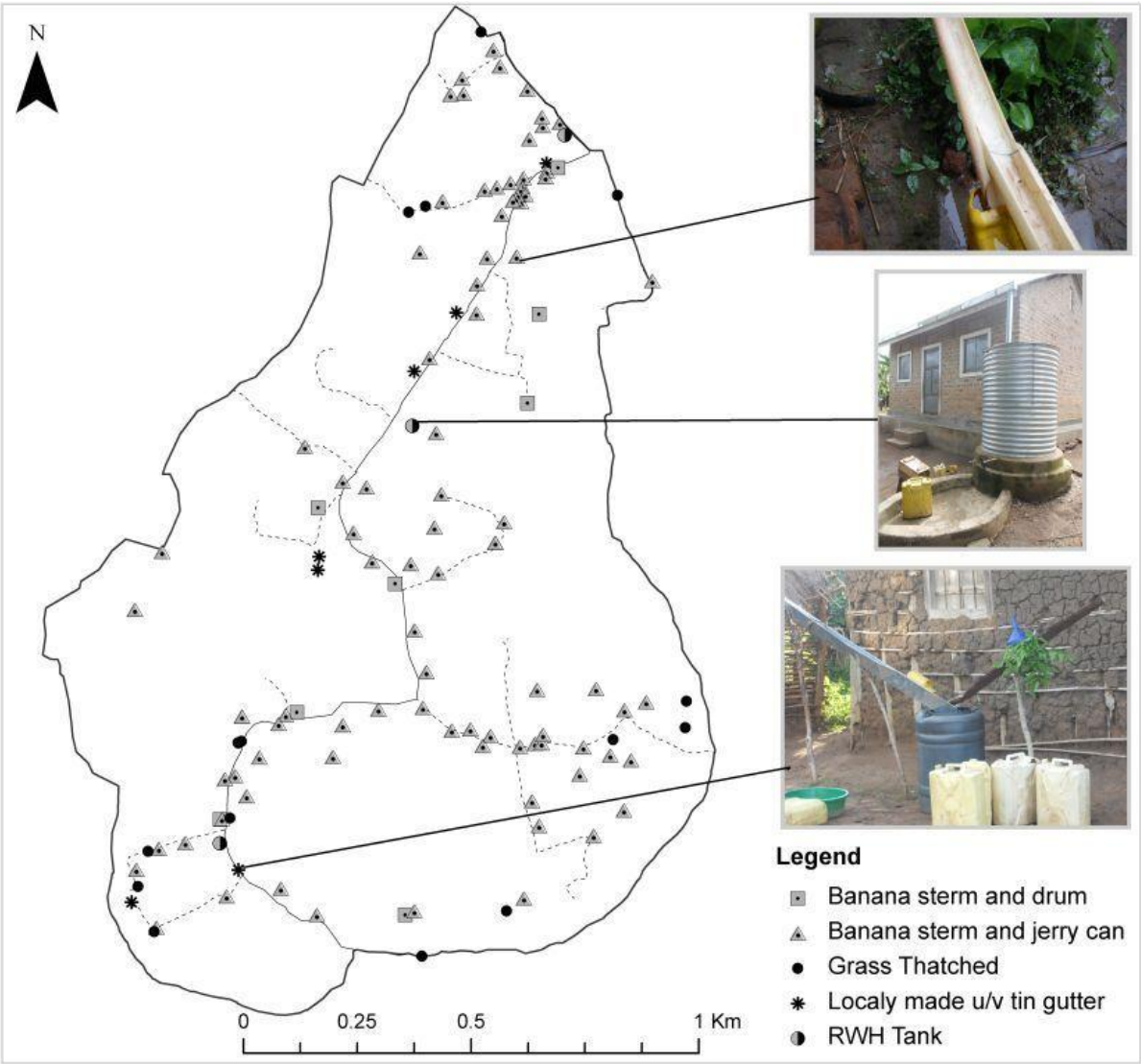
[8] See Jones' (2011) discussed on paying for borehole water and obstacle to sustainable water access.

4.3.2 Revealing the use of rainwater harvesting technologies

A major consideration in understanding adaptive capacity regarding water is whether community members can harvest and store rainwater. A part of my work was therefore aimed at revealing the use of rainwater harvesting (RWH) technologies among community members. With this in mind, I used PGIS here to ask villagers to collect data on RWH. They first identified three houses which had large installations of 1000- litre tanks. But further discussions with community members indicated that RWH is actually used by almost all households in the village. Households with iron sheet roofs harvest rainwater during every wet period. I subsequently went with villagers to conduct GPS-assisted mental mapping of households in the village with a view to identifying houses with iron sheet roofs (Figure 4.3), which indicated that, at a minimum, RWH practices are far more widely used in the village than my initial research suggested.

Critically, during one such walk and talk around the village, an elderly man and woman told me that RWH has been an integral part of their water management since they moved to Kiganjo in the early 1950s. They explained how they would use fresh banana stems to harvest water falling from rooftops. Many others do likewise. Indeed, of the 125 households in Kiganjo, 105 (84%) practiced RWH and 91 of them used fresh banana stems to trap falling water from the roof, while seven used locally made gutters from old iron sheets. Crucially, those who could not harvest water because they had grass thatched houses were often compelled to ask for fresh water from their neighbours, a level of dependence which might limit their capacity to endure longer dry periods.

Figure 4. 3: Spatial distribution of rainwater harvesting practices in Kiganjo



In addition to the fact that RWH enables more frequent washing of clothes and more water for bathing (from three liters in dry periods to ten liters), the broader significance is that 'basic' RWH gives a major boost to village productivity during periods of sufficient rainfall. In this regard, the use of modern-day, expensive but efficient RWH tanks is particularly important. Having a RWH tank creates the possibility that a household can retain access to water during the dry season, thereby increasing their capacity to cope and develop other ways of adapting. But

having a tank is one thing; using it effectively is quite another. For example, I found that some households were unable to effectively manage their tank. At the end of the rainy season in May, a 1000 litre tank would be full after two days of 'good' rainfall. This water could potentially provide water for at least three weeks if used with minimum control but there was the potential for it to last three months if used sparingly, that is to say, used only for drinking. If a household with a tank is headed by a child, for instance, there is a strong likelihood that other household heads will come and draw water; a child is unable to oppose the wishes of elders. Then there is the possibility that if a household with a tank is elderly some neighbours will try to take advantage and draw excessive water from the tank. Alternatively, of course, a household with a tank might be very careful about how their water is used, perhaps if the tank is managed by someone who is educated, perhaps someone who offers water to neighbours but pleads with them to use it sparingly and who only uses water in the tank for drinking. The point is that having an asset does not necessarily mean it will increase adaptive capacity; rather the resource must be coupled with the capacity to manage and contend with multiple pressures at the household level. Moreover, as these sorts of scenarios indicate, the capacity to use RWH is always going to be highly differentiated.

4.3.3 The use of PGIS in a community-oriented workshop

The third and final way PGIS helped my research was in the workshop that I organized towards the end of the fieldwork. Recognizing that adaptive capacity is as much about what happens outside the village as it is about what happens within (Adger et al., 2005; Pelling, 1999), my research aimed to assist community members to use the output of the PGIS to communicate their situation more compellingly to decision-makers. With help from villagers in Kiganjo, I invited

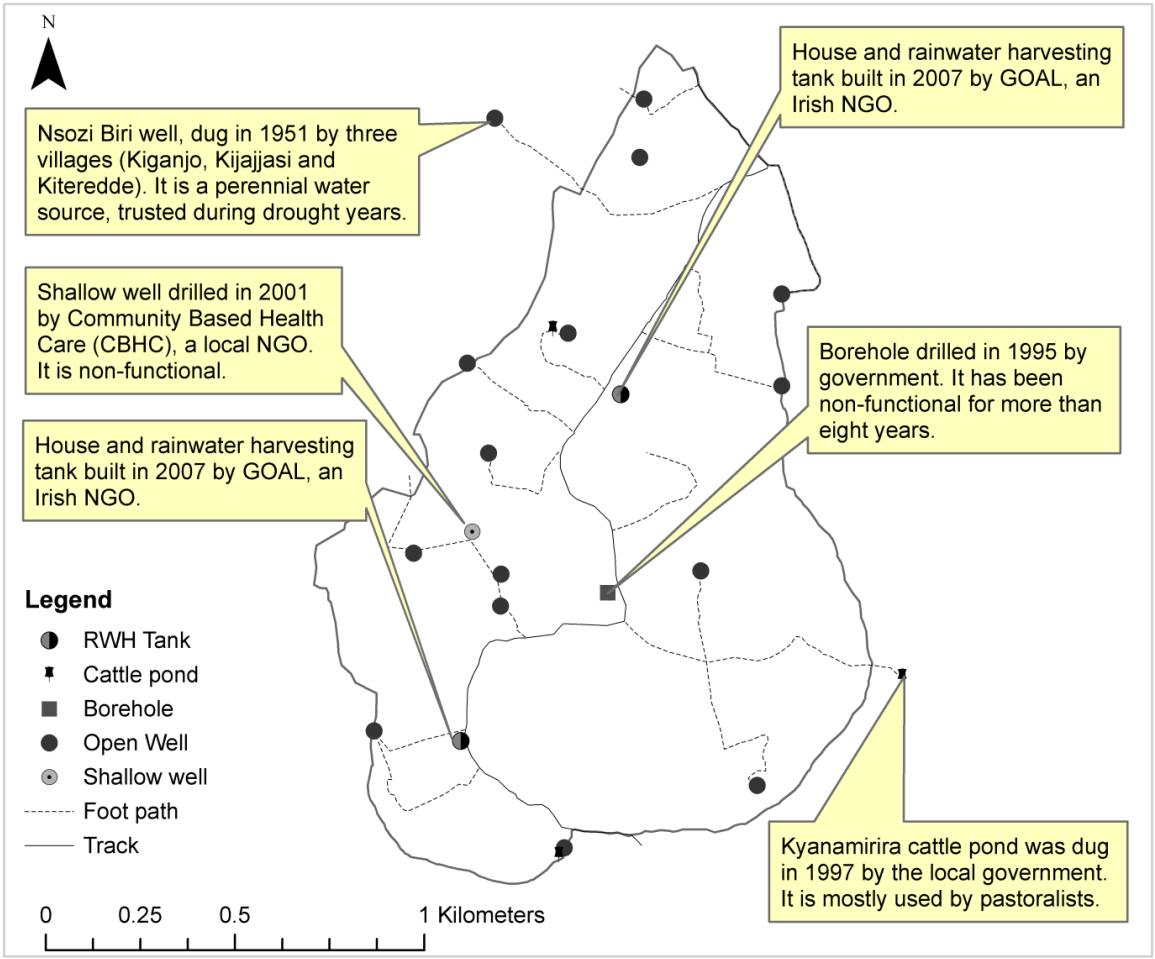
district and sub-county officials and planners, politicians at sub-county and village level, officials from NGOs, and members of nearby communities to the workshop. We agreed to use Luganda as a local language for communication and to use a traditional workshop arrangement because it promoted face-to-face discussion. The event, which lasted six hours, had 61 participants. In the morning session, villagers made presentations about their situation in the village as regards to adaptive capacity. Each presenter distributed printed maps that they had helped to produce (e.g. Figure 4.3) showing village settlement development and boundaries, the functionality of different water sources, and RWH initiatives and potential. In the afternoon sessions, the workshop turned to group discussions where issues raised in the presentations in the morning session were discussed.

One major issue that emerged in the morning sessions was about non-functioning boreholes and shallow wells. Using the map in Figure 4.4, some of the community representatives explained why their borehole and shallow well were non-functional. Men suggested that factors to blame included political interference, service providers' inefficiencies, and communities' lack of knowledge on what is expected to access services from providers such as local government. Women also described where they currently fetch water. The district water and public health officials were alarmed about where people fetched drinking water. Open wells where people currently fetch water are considered 'unimproved and unsafe water sources' which the government has said it wants to abolish (GoU, 2006). Indeed, in introductory remarks at the beginning of the workshop the District Water Officer claimed that 59% of all water sources in

the district were functioning and furthermore that the Kiganjo borehole was included in this figure.

I argue that knowing and seeing where villagers sourced their water left an impression on the service providers. The spatial information the villagers had compiled made a difference because they could refer to the map and use the map's authority, its official appearance, and political and 'scientific' nature to communicate their situation.

Figure 4. 4: An example of a map used in the workshop



The community-oriented workshop revealed that households, occupational groups, local leaders, and extra-local actors were responsible for shaping the acquisition and distribution of resources and interventions in fundamental ways, thereby affecting the degree of success of coping mechanisms in Kiganjo. The workshop also shed light on the complex connections between community members and extra-local actors. The data reported in Figure 4.4 are an example of some connections that exist in Kiganjo as well as the historical development of water supply initiatives since 1951. Participants explained in the workshop that for so many years the village has depended on open wells but in 1995 a borehole was drilled and this was followed by a shallow well in 2001 although both water sources have not satisfactorily supplied the needed water to the village. These improved water supply technologies are connected to various extra-local actors. During workshop discussions, community members' explanations were emotionally charged as they communicated how their adaptive capacity is shaped by these connections.

Regarding some of the many challenges facing people Kiganjo, the workshop also provided insights into how assets and knowledge are exchanged, integrated, and shaped through connections with extra-local actors. Shakul's and Jude's [not true names] questions to the District Water Officer shed more light on this:

> *Shakul*: "How can you help us who live on hilly places to access water easily?"
>
> *Jude*: "Why is our borehole not functioning when you have told us you have expertise and funds?"

Shakul's question triggered the extra-local actors to list technologies that are made available to communities, such as a borehole, shallow wells, RWH tanks, valley dams, hand pump spares and

non-material assets, mainly expertise and training of water user committees. Participants from Kiganjo were shocked when they heard about this wide range of technologies and services available to them. This new awareness raised the expectation on the part of the community and immediately they started demanding for RWH and for their borehole to be repaired. But the District Water Officer emphasized that it is not automatic that communities can get the technology and services they need because there are procedures to be met. The District Water Officer suggested that the other actions were necessary:

> "Don't just wait for technology to come to you. Do something. Put in some effort to solicit support..." (Workshop Proceedings, 21 July 2011)

In particular, the District Water Officer emphasized the need of 'doing something' that meant that the community members need to democratically elect a 'water user committee' and 'to pay' for water drawn from improved water facilities beyond in-kind contributions, such as attending meetings. Extra-local actors emphasized that water user committee because it a formal entry and contact point into the community. Also, it is through the water user committee that a community can channel their request regarding water services needs to District Water Officer, NGO officials or hand-pump mechanics.

Responding to Jude's question noted previously regarding the borehole, the NGO official explained that:

> "...the mistake you make is that instead of soliciting for help to repair the boreholes or shallow wells, you keep waiting and looking forward to a person who constructed the

water source to come and repair it, yet you don't inform this person..." (Workshop Proceedings, 21 July 2011).

The water source Jude was referring to was a shallow well that was facilitated by a former NGO employee. As a result, community leaders thought there is no one else to assist them repair the borehole. Jude's problem, then, is a reflection of poor communication between the community and service providers. This incident supports my claim that information about adaptive capacity, including borehole repair or management, is not equally accessible to all, either because of the manner in which it is communicated, the channel used or the extra-local actors involved.

The foregoing discussion regarding a communication gap yielded some positive resolutions by the end of the community-oriented workshop. First, extra-local actors seemed to recognize local coping mechanisms, particularly traditional RWH, that they can build upon as one way of realizing sustainable water supply at the micro-scale. Extra-local actors realized that successful adaptive capacity is unlikely to be undertaken by a single solution and institution, but rather a mixed approach. Community members were encouraged to treat their water from open wells before consuming it while they are waiting for repair of the borehole. Village leaders indicated that they will revamp water user committee now that they knew what they are supposed to do. As I have indicated already, on the part of extra-local actors, the idea of regular communication hinged on a functioning 'water user committee'.

Second, community members gained new awareness regarding services made available to enhance adaptive capacity and looked forward to electing new water user committee and connect

it to services providers. This point connects with the third resolution about the need to continue with similar workshop beyond my research. Participants proposed holding community-oriented workshops twice a year because the present workshop enabled them to resolve some of the many issues facing them.

Finally, the officials responded by resolving to meet their obligations to provide services and to begin networking regarding water governance in Kiganjo and more broadly across Makondo Parish. Some officials shared their mobile phone numbers to communities in order to improve networking. But perhaps the most important outcome of the workshop was that service providers released funds that might not otherwise have been directed towards Kiganjo, for example, Parish and a private pump mechanic repaired a borehole in Kiganjo after the District agreed to purchase spare parts, CBHC (Community Based Health Care) funded applications to repair three shallow wells in Makondo.

Post-hoc analysis of the workshop revealed that although extra-local actors acknowledged the benefits of the community-oriented workshop neither of them (government, NGOs and hand-pump mechanics) was committed to taking on the responsibility of implementing organizational change to accommodate my research initiative. The obvious limitations, which appeared during the workshop and my follow up interviews was budgetary limitations. They all indicated that support for regular meetings to solicit ideas or share ideas at the community level lacks funding and therefore it could not be done in practice. Interestingly, in the context of this specific issue key informants wondered how this might happen without a lead institution. No one was keen

enough to commit to another community-oriented workshop. Bottom-up knowledge integration therefore may not get full support from the extra-local actors unless there is pragmatic shift in perception regarding 'local' knowledge (e.g. Cannon et al., 2003, Brigg, 2005 and van Aalst et al., 2008).

4.5 Summary

In this Chapter, I have used the case of my research in Kiganjo to demonstrate that PGIS can help to reveal critical data about people and their place that might otherwise not emerge. PGIS can characterize water resources and the identification of the use of rainwater harvesting technologies. By using PGIS, a new map of Kiganjo has emerged and this spatial information has allowed villagers to inform decision-makers about their situation. Going a step further and combining PGIS as part of ethnographic enquiry offers a methodology that redresses the perceived gaps in using any single approach. But ethnographic enquiry, in the research outlined here, has also improved the rigor of PGIS, revealing complex realities about adaptive capacity in relation to social connections between specific places and formal and informal social networks. Furthermore, my work suggests that use of PGIS in the community-oriented workshop can help to integrate knowledge about coping mechanisms between communities and extra-local actors.

In addition, my work suggests that criticisms of PGIS can be greatly reduced if its practice is combined appropriately with ethnography. In particular, my work suggests that we can offset some of Elwood's (2006: 700) concerns regarding PGIS research practice within Critical GIScience that aim to empower communities; specifically, in terms of inclusiveness of their

knowledge production practice, empowerment potential, and capacity to inform influential decision-makers. The combination of ethnographic methodologies with PGIS can be a tool for capacity enhancement of communities. Existing dilemmas regarding the use of technology and power differences notwithstanding, my work suggests that such approaches can help communities to communicate their situation to decision-makers, which can lead to a shift in attitudes, the creation of new knowledge and, in the case of Kiganjo, in resources being released by local government.

In Chapter Five, coming next, I unpack relations at the local level in order to learn how action occurs and practices adjust to climate change at the micro-scale. I also seek to calculate how relations with extra-local actors might affect adaptive capacity regarding domestic water at the household level.

CHAPTER FIVE

UNDERSTANDING ADAPTIVE CAPACITY TO CLIMATE CHANGE IN RURAL AFRICA: EVIDENCE FROM MICHUNDA AND KIGANJO

5.1 Introduction

In the previous chapter I used the case of my research in Kiganjo to demonstrate that a dynamic assessment (PGIS) can help to reveal critical data about people and their place that might otherwise not emerge. In this Chapter, I unpack how intra- and extra-household relations matter if we are to understand how action occurs and practices adjust to climate change. The Chapter pays specific attention to how actors might adjust their practices to deal with the effects of climate change and attempts to grasp how relations with extra-local actors might affect adaptive capacity. Using a case study of two villages in Makondo Parish in Uganda, I build upon literature that explores adaptive capacity at the micro-scale of action and practice in rural Africa. The research employed context-sensitive methods, specifically ethnographic and participatory methodologies. The results reveal some of the range of relations and practices that shape the adaptive capacity of people in these areas to cope with seasonal water variation. Although at the household level people display context-based adaptive strategies, such as water recycling and seasonal adjustments, I found that gender-based and village-level governance differences regarding future adaptive strategies limit adaptive capacity. I suggest that, at the micro-scale, adaptive capacity strategies require efforts that address multiple limitations with regards water

governance, because these limitations may be associated with the various determinants of adaptive capacity.

In this Chapter, then, I consider how people in rural areas of Sub-Saharan Africa might cope with some of the apparent implications of climate change (IPCC, 2007). The prospect of climate change occurring presents numerous serious challenges for rural Sub-Saharan Africa, where so many people are still heavily reliant on surface water and unimproved ground water for domestic consumption (de Wit and Stankiewicz, 2006; IPCC, 2007; Kundzewicz et al., 2008). In particular, if climate change models are correct then longer dry spells will occur, which will lead to water shortages and possibly conflict over water resources (Boko et al., 2007). As a consequence of this looming scenario, it is important that the research community asks how people might deal with and adapt to climate change. Given the centrality of water to the everyday lives of rural Africans, related questions in this context are how communities currently manage and govern their water resources and how they might adjust or adapt those practices in the future. It is also important to note, however, that village-level practices regarding water unfold within a broader context – and, with regards to water, a critical issue in the contemporary period is that particular water governance regimes have emerged and have become critical factors to consider across Sub-Saharan Africa (e.g. Cleaver and Toner, 2006). For example, in many areas there has been a shift towards community-based rural water management propped up by support from extra-local actors such as non-governmental organisations (NGOs) and local governments, alongside privatized and commercialized service delivery (Jiménez and Pérez-Foguet, 2010). As such, asking about the possible scope that exists for communities in rural

Africa to develop their adaptive capacity to deal with climate change entails locating inquiry with respect to the water governance regime. This article examines these issues using the case of two villages in southwest Uganda.

To inquire about adaptive capacity is not a straightforward issue, as the concept is challenged from both a theoretical and a practical point of view (Engle and Lemos, 2010). The theoretical problem is that often rather static measurements are used to measure adaptive capacity: currently, adaptive capacity studies have focused on aggregate assessments at the macro-level and the practical problem is contextualization of the macro-scale aggregated assessment indicators of adaptive capacity at the micro-scale. The literature shows that the macro-scale indicators are too broad for contextualization and need unpacking for practical application at the micro-level (Engle and Lemos, 2010). Since the task is to understand everyday practices of water management and to assess potential adaptive capacities within communities and between communities and extra-local actors, I use a mixed methods approach, with the understanding that neither quantitative nor qualitative methods are sufficient in themselves to yield data to appropriately understand the situation on the ground (Creswell and Clark, 2007). My research seeks to shed light on adaptive capacity of the communities by examining daily practices, coping mechanisms and adaptive strategies, but also by exploring how water management is influenced by the broader water governance regime in Uganda. The two villages are in Makondo Parish, Lwengo District.

This Chapter is organized as follows. I first locate my work relative to literature that explores the adaptive capacity of rural communities, especially the literature concerned with water governance (e.g. Cleaver and Toner, 2006; Jiménez and Pérez-Foguet, 2010). I then review my methodological approach, at which point I discuss some of the challenges in conducting research of this nature. In the next section of the Chapter, I introduce my findings, which I organize in two parts. The first of these concerns the maelstrom of intra-locality relations through which people manage water and its limited availability. The second way examines how community relations with extra-local actors shape adaptive capacity by drawing attention to some specific practices at village level.

5.2 The role of water governance in studying adaptive capacity to climate change in rural Africa

A sizeable literature has emerged to assess the adaptive capacity of a wide range of systems to climate change (UNDP, 2004; Smit and Wandel, 2006). There is considerable urgency to this task of assessment because climate change is already occurring, which means interventions are needed from governmental and indeed non-governmental actors to support existing adaptive capacities or develop and enhance the adaptive capacity of vulnerable communities (Smit and Wandel, 2006).

5.2.1 Understanding adaptive capacity to climate change in rural Africa

Although all regions of the world are vulnerable to climate change, Sub-Saharan Africa stands out among all others due to its relative poverty, so that its countries are generally not well

positioned to meet the financial requirements to support or enhance the adaptive capacity of the local communities (Boko et al., 2007). Within Sub-Saharan Africa WHO and UNICEF (2012) have estimated 175 million people reside in rural areas without access to an improved and reliable water source. Therefore, in view of the possible climate change, attention is needed to be paid to the adaptive capacities that exist within and between villages and how these can be initialized to fight climate change. To harness existing and potential local capacities to cope with climate change is a necessary thing though complex endeavour. In part this is due to variations within villages, like differences in age, level of education or class position (e.g. on Mozambique, see Bryan et al., 2009 and on Uganda, see James, 2010). Harnessing of capacities is made more complex by heterogeneous coping mechanisms due to variations in the effects of climate change at the village level (Trærup and Mertz, 2011). The use of adaptive capacity is on the one hand complicated further by cultural barriers, such as whether people can make appropriate changes regarding crop selection (Codjoe and Owusu, 2011 and Nielsen and Reenberg, 2010) or technology (e.g. on rainwater harvesting in Uganda, Baguma and Loiskandl, 2010). This is further complicated by the fact that value of adaptive capacity to climate change is not always understood by local people, nor is it always the most important issue for them as noted by Mertz et al. (2009) and Mertz et al. (2011). For example, new agricultural production strategies are largely based on wider social or political-economic concerns, such as health, education, and road network accessibility, rather than explicitly on climate change variability.

On the one hand, there is considerable complexity to consider. In part, this is due to variations within villages. Within villages, for example, there are differences according to age, level of

education or class position (e.g. on Mozambique, see Bryan et al., 2009 and on Uganda, see James, 2010). There is also the complexity raised by heterogeneous coping mechanisms given variations in the effects of climate change (Trærup and Mertz, 2011). Adaptive capacity is complicated further by cultural barriers, such as whether people can make appropriate changes regarding crop selection (Codjoe and Owusu, 2011 and Nielsen and Reenberg, 2010) or technology (e.g. on rainwater harvesting in Uganda, Baguma and Loiskandl, 2010). Adaptive capacity to climate change is not always understood by local people, nor is it always the most important issue for them with regards their adaptive strategies, as noted by Mertz et al. (2009) and Mertz et al. (2011). For example, new agricultural production strategies are largely based on wider social or political-economic concerns, such as health, education, and road network accessibility, rather than explicitly on climate change variability.

On the other hand, adaptive capacity is shaped by governance mechanisms and processes. For example, Osbahr et al. (2010) note the centrality of relations between formal and informal institutions in shaping adaptive capacity. Chikozho (2010) argues that there is a need to consider how expert and lay knowledge about technologies can be fused, which calls attention to the mechanisms and processes through which policy and practice are governed. Also important is the way adaptive actions within rural Africa connects with the ideas and practices of NGOs, which are not always helpful (see West et al., 2008), and the way climate policy emerges in relation to broader development policy (see Chuku, 2010). Connecting with foregoing contributions is a body of work that calls attention to the importance of governance at different levels. James (2010), for example, discusses how, at a local level, farmers weigh their knowledge and

understanding of local circumstances against the Ugandan government's Plan for the Modernisation of Agriculture 2010. Understanding adaptive capacity at the local scale entails positioning action relative to national policy, something which Derbile and Kasei (2012) note with regards to smallholder families in Ghana who develop new capacities but need better national-level policy interventions such as facilitation of better access to new crop seeds. The question of whether national-level policy formation can take into consideration local capacities is also of interest in the literature (e.g. Stringer et al., 2009) given that, as Mortimore (2010) argues, local adaptive capacities can be a 'platform' for creating policy strategies to address vulnerability. National policy can create an enabling environment for the building of adaptive capacity but it can also ignore locally defined goals, or be obstructive.

5.2.2 Water governance and adaptive capacity in rural Africa

Water is an obvious and important consideration in understanding adaptive capacity in rural Africa, regardless of whether there is lower or indeed more intense or erratic rainfall (Boko et al., 2007). But understanding the role of water resources in adaptive capacity is a complex issue given the wide range of contexts and the numerous overlapping institutions and actors involved (Jacobs, 2002). One useful way to conceptualize this complexity is to focus on 'water governance', which Bakker (2003) defines as, "the range of political, organizational and administrative processes through which communities articulate their interests, their input is absorbed, decisions are made and implemented, and decision makers are held accountable in the development and management of water resources and delivery of water services" (Bakker, 2003: 4). A focus on water governance can help understand and explain adaptive capacity, specifically

by looking at what happens within villages in rural Africa but also at the relations between people living in villages and external actors, such as municipalities, NGOs and international donors, or national government. In this regard, two interrelated issues stand out.

The first of these is that, when it comes to making decisions and implementing water management practices on the ground, it is essential to note the central role rural African women play in fetching and using water (see Boone et al., 2011; Sorenson et al., 2011). The gendered division of labour in rural Africa tends to limit men's participation in daily water management, hence there are often differing ideas between women and men about how water should be used (Makoni et al., 2004), with men looking to use water for brick making, while women's priorities might be for cooking, hygiene and sanitation (on similar patterns regarding urban water use, see Buor, 2004). One problem in such situations is that men might lose interest in sustaining access to improved water sources and hence fail to offer sufficient support for investing in water (Hunter, 2006). Power relations in many communities affect water governance in ways that disproportionately burden women and undermine the sustainable governance of water resources, even rural households' and communities' adaptive capacity (Ruettinger et al., 2011; Kansiime, 2012). Assessing how water governance shapes adaptive capacity to climate change means paying attention to the practices and outcomes of gender relations within villages.

The second issue is that material relations between villagers can shape the way water governance occurs. In this sense a striking development is the extent to which water governance is becoming commercialized and sometimes privatized. For example, in rural villages in Tanzania informal

water governance practices have been replaced by much more formal relations that commercialize water, while some rich villagers take control over day-to-day operation of water taps (Cleaver and Toner 2006). Moreover, commercializing rural water supply in Tanzania has led to poorly constructed water infrastructure and reduced capacity of the villagers (especially the poor villagers) to participate in decision-making processes on issues concerning water (Jiménez and Pérez-Foguet, 2010). More generally, it is reasonable to foresee scenarios in which those who can afford to pay money to fix a shallow well's pump might refuse to do so without guarantees that they receive preferential access to water (on other issues to do with payment for rural water, see Jones, 2011). Of course, gender relations also matter here, especially insofar as it is men who tend to run businesses such as water point operators and hand-pump mechanics (e.g. regarding Tanzania, see Cleaver and Toner, 2006).

One important factor here is what Pahl-Wostl (2009) refers to as the 'water governance regime'. The specific form of any one regime may vary but generally speaking a water governance regime is an emergent entity influenced by formal and informal institutions, state and non-state actors, unfolding via what Pahl-Wostl calls 'multi-level interactions' constituted by 'bureaucratic hierarchies, markets and networks' (p.363). Across Sub-Saharan Africa, water governance regimes shape the way that the state, private and community sectors and the NGO sector interact to manage water resources (Boko et al., 2007). Given these developments, it is no longer sufficient to consider solely the role of governmental actors; rather, NGOs, private and corporate sector actors and indeed community-level actors all now play roles in the governance of water resources.

The case of Uganda is illuminating in this regard. The state's highly constrained fiscal situation means that its spending on water has not grown in line with population growth. Furthermore, its relationship with global development institutions has evolved in such a way that private-sector and community-based management have been viewed as 'solutions' to its spending limitations (Carter and Rwamwanja, 2006). In this sense, therefore, the combination of private-sector and community-based management is a key structural characteristic of the Ugandan water governance regime (Carter and Rwamwanja, 2006; Baguma and Loiskandl, 2010). Although private-sector interventions are sometimes significant in rural areas – for example, there is a market for rainwater harvesting equipment for those that can afford it, and private-sector hydrological engineers and pump mechanics are heavily prevalent within the water sector – community-based management is by far the most widespread. Community-based rural water supply initiatives have been led in the past 20 years by local and international NGOs, most of whom played no role during the pre-1990 period (Carter and Rwamwanja, 2006). Indeed, Uganda now has 180 NGOs active in water supply and 56% of these NGOs work in rural areas (UWASNET, 2011). The Uganda Water and Sanitation NGO Network (UWASNET) indicates that NGOs are active in the construction of water facilities, community and local government capacity building and hygiene promotion, as well as in funding water projects. NGOs have also coordinated and collaborated with local governments in various aspects of water provision, such as feasibility reports and the installation of new facilities (Carter and Rwamwanja, 2006). In the last twenty years there has been a wave of spending on improved water technologies, such as boreholes, shallow wells, improved springs and rainwater harvesting. All of these activities have occurred alongside social innovations regarding sustainable water practices and 'capacity

building' (GoU, 2011). The result, in many instances, has been better, more sustainable, and safer water availability.

However, there are important unintended consequences of Uganda's water governance regime to consider here. At the very minimum, there are risks that people in donor-dependent communities become too reliant upon external funding for maintaining improved water sources. But there is also the risk that such interventions are poorly planned or implemented, and as such can create tension and even outright hostility between 'beneficiaries' and donors. In addition, community-based water management relies on levels of participation and collaboration within villages that may not always endure. The sustainability of such management is dependent on existing democratic processes that can meet a real need of the community and also ensuring that the community is fully involved in decision-making, building on what people already know and do, selecting appropriate (manageable) technology, and good quality construction (on the factors necessary to achieve sustainable rural water supply as well as adaptive capacity in Uganda, see Carter and Rwamwanja, 2006; Kansiime, 2012). For these reasons, some scholars have raised concerns that donors, NGOs and government 'do not always listen, they can be very negative' and sometimes assume that one-size-fits-all even though they 'don't know it all' (Carter and Rwamwanja, 2006: 21).

In summary, then, water governance is a crucial consideration when studying adaptive capacity in rural Africa. Paying attention to water governance entails looking at practices within villages, particularly the ways in which individuals and households currently deal with climate variation.

But how villages interact with the broader water governance regime must also come into focus, hence relations that I refer to as 'extra-local' need to be considered. The next section of the paper reviews the methodological approach I used to understand adaptive capacity in two villages in southwest Uganda, a discussion which is followed by my findings section.

5.3 Dynamics of adaptive capacity to climate change

In this part of the Chapter, data I collected in the field are used to develop an understanding of how adaptive capacity is affected by (a) the dynamics of water governance within the villages and then (b) the villages' extra-local relations within the context of Uganda's water governance regime.

5.3.1 Coping mechanisms and the limits of water governance in Kiganjo and Michunda villages

As noted above, both study villages face difficulties in accessing sufficient water of a suitable quality to meet their livelihood needs. There are, of course, seasonal variations to consider here. In the wet season, for example, water is quite freely available. Indeed, in Michunda the average household in the village can fill a five litre jerry can in less than ten minutes from one of the wells. The easy availability of water in the wet season enables households in both villages to wash themselves twice daily and to wash clothes once per week, and they have plenty of water for cooking. The wet season also allows them to spend more time on agriculture and to use as much water as they need for brick making.

In addition, 97% of the households in Michunda practice traditional rainwater harvesting (RWH) using fresh banana stems and another 9.4% have 1000 litres RWH tanks installed. A similar situation can be found in Kiganjo, where 84% of the households practice RWH, although only 2.9% of the households have RWH tanks installed; the other 16% of households could not harvest any rainwater because they had grass thatched houses. Clearly, therefore, the vast majority of households in both study villages are well-placed to make the most of the wet season. This reflects a significant degree of investment by households in preparing for the dry season. But with 65% of households in Michunda and 71% in Kiganjo having between five and fourteen household members, they find coping with water problems in the dry season a huge challenge because of the shortage of water storage facilities. Findings reported in Table 5.1 show there is differential ownership of jerry cans between surveyed households that shape their coping capacity, especially among the larger households. The majority of these households are in Kiganjo (84.13%), owning three or less than three jerry cans, while in Michunda the proportion of these households is lower (45.5%). In Michunda the larger proportion of households has more than four jerry cans with some households owning as many as 12 jerry cans. As I have already indicated in Chapter Three, the employment situation in Kiganjo has a bearing on the number of jerry cans households can own. Owning additional water-carrying and water-storage facilities is clearly crucial for households' adaptive capacity. Consequently, this need for water storage persuades many women in the villages to prioritize investments in water storage facilities as a first step towards enhancing their adaptive capacity.

Table 5.1: Household plastic jerry can ownership in the study villages

Jerry cans per household	Kiganjo	Michunda
	Percent (%)	Percent (%)
1	15.9	1.3
2	35.2	20.8
3	33.0	23.4
4	7.9	19.5
5	3.2	10.4
6	1.6	14.3
7	3.2	5.2
8	0	1.3
9	0	1.3
12	0	2.6
	100.0	100.0

Many women also talk about how water abstraction technologies (mainly the boreholes and shallow wells) are not dependable enough. Though villagers recognize that the shallow wells require further investment, they still tend to invest simply in more jerry cans for water storage, mainly because the shallow wells in Michunda do not yield water in the dry season, even when they are functioning. Women in Michunda claimed that they preserve their open wells as a coping mechanism in the dry season because they do not have trust in shallow wells which dry up midway the dry season and often times breakdown:

> "We don't completely abandon our wells because in dry season *nnayikondo* [shallow wells] dry-up and frequently shallow wells breakdown. So we depend on our open wells." (Personal Interview, March 4, 2011).

The major boost RWH provides is that it frees resources, not least their children's (girls and boys) capacity to labour: like in many other areas of Sub-Saharan Africa, 86% of domestic water is collected by in Michunda and Kiganjo villages. The broader significance is that 'basic' RWH gives a major boost to village productivity during periods of sufficient rainfall. As one female respondent noted:

> "Rainy season brings water to me. […] My grandchildren can rest from fetching water and work together with me in our banana and coffee plots" (Personal Interview, 30 April 2011).

In both Michunda and Kiganjo, local coping mechanisms change dramatically during the dry season. RWH (traditional or otherwise) soon becomes redundant and stored water is quickly used up; consequently more time has to be spent collecting water, principally from open wells. Water collection times change, with some households needing to begin as early as 4 a.m. (instead of 6.30 a.m. during the wet season) to fetch 'clean' water, that is, water not soiled by animals. If there is money in the household, some water might be delivered by bicycle or motorbike from local providers, mostly young men.

New coping mechanisms are introduced to deal with water scarcity. One such mechanism within households entails negotiation and adjustment regarding water use. For example, water recycling occurs when using multiple containers when washing dishes or clothes. One woman explained this practice as she carried out some chores:

> "When washing my plates I wash in this [first bowl of] water. If I'm through with this water, I put the dishes in another basin and another one. The first water is given to pigs. I keep the second and third water. In my next washing I just use this one [the second basin], and this one, [third basin]. But, now you add clean water in this basin [first basin]" (Personal interview, 24 February, 2011).

Other austerity measures occur. Just over 80% and 91% of households in Michunda and Kiganjo re-use clothes without laundering to reduce the amount of water they use, although households with babies (19% in Michunda and 10.4% in Kiganjo) still allocate water for washing babies and their clothes. Women, in particular, speak about how water shortages pose a threat to hygiene and sanitation. Many believe that being unable to bathe daily with enough water results in ringworm, especially for children below 10 years of age.

In addition, most respondents in both villages indicate that, whereas the water needs of men might have been given priority during the wet season, men drop down the pecking order during dry periods. They receive less water for bathing, often as little as three litres per day. One married couple describes their flexibility regarding water use in dry periods thus:

> *Wife*: 'I make sure we have water for cooking somewhere. In drier months my husband is given less water to bath. Our priorities change....'
>
> *Husband:* 'She is right. I must be responsible; we get water from the springs [3.5km away]... I also re-use my clothes.'

Wife: '...but if we have a baby like in 2000, the baby is prioritised. It can be hard. But now she [the child] is collecting water, things are better for us.'

(Personal interview, 23 February 2011)

Thus, women talk with their husbands to make appropriate decisions about water and many men take corresponding action. This is a crucial coping mechanism in patriarchal families in which women bear the burden of water management.

But the dry season also raises new challenges due to lack of appropriate technologies for water abstraction and RWH with which some coping mechanisms struggle to deal. For example, as the first open wells begin to dry, queues at the remaining wells grow longer. Tensions increase and occasionally boil over. There are disagreements, arguments and sometimes even violence. Although in both villages there have been village-level tribunals to reduce tensions, these have lost authority in recent years, which some respondents attribute to government attempts to undermine traditional governance practices. Others suggest that younger villagers no longer respect traditional practices and indeed many young men who are casually employed to fetch water for other households often jump the queue to collect water at open wells. Some young men show disregard for tradition by arguing that elders have failed to secure adequate access to safe water. Some even suggest that they need not pay for the maintenance of shallow wells because their payment to leaders was in the form of voting at election time; as one young man said:

"We campaign for councillors and give them our electoral votes. We are also promised to benefit from relief of repairing shallow wells. They even promise to

bring more. So we don't see it worth paying for water" (Personal Interview, 15 July 2011).

For other community members, however, water problems in the villages stem from their poverty. Some argue that the burden of maintaining water sources is too high compared to their incomes and livelihoods needs. This is revealed in interviews with some community members in Michunda who said:

> "Even if we can contribute a certain amount of money, it can only maintain one shallow well. Now we have two or three in our village. Can we manage? We are poor" (Personal interview, 16 February, 2011).

Another village member in Kiganjo explained further that,

> "We need safe water. We wish we repaired all our water sources but because of poverty we struggle to earn money for school fees, firewood, and medicine. There is no government health clinic and we have to go to private clinics. These are challenges to allocate income we earn from seasonal crop sales. We can't also manage to pay for shallow well repairs" (Personal interview, 16 February, 2011).

Hence, although communities have some capacity to develop solutions to dwindling water availability as the dry period extends from June into July and then into August, that capacity is heavily constrained by the perception that their incomes are limited. In addition to income challenges, women argued that the household size or number of dependants in a household complicated water management at home during scarcity periods. In both villages, for example,

women named the 2007 and 2008 dry seasons '*Nezaalabaaki' – why did I give birth to all these children*?' Mothers with large families (5+ children) complained of having a very tough time managing water those years. Women claimed that they spent a lot of time queuing for water but they could not collect enough because they were not able to carry enough at one time; consequently they make many trips to collect water. The lack of enough storage facilities such as jerry cans complicated the management of water further.

Thus, in both villages, dry periods are a time of endurance in which micro-scale adjustments alter practices and relations with a view to making water last longer. Households also try to cope by making investments in jerry cans or RWH. There is some adaptive capacity that draws on knowledge of how to manage dry periods, but these difficult and often insufficient as they are in the current climatic change conditions will be insufficient once climate get drier as climate models suggest. Still, as communities in Makondo continue relying on surface water and unimproved ground water for domestic water consumption, these micro-scale of adjustments in water governance will be the first line of defence to cope with the anticipated longer dry periods.

5.3.2 'They do what they want': NGOs and water governance in Kiganjo and Michunda

Of course, any adaptive capacity to climate change in a place such as Makondo Parish has to be located relative to a wider context. At issue are the ways in which individuals and households connect with and are affected by extra-local actors, particularly (sub-national and national) government agencies but also NGOs. But with regards to water in particular, although

government does play a role by drilling boreholes and in some cases maintaining them adequately, NGOs seem to be the most important extra-local actor present in Makondo. Indeed, in the last two decades, NGOs have been extremely active in shaping water governance, although often in ways that complicate adaptive capacity. The NGOs have been central is setting up formal village Water User Committee (WUC), which is a linking institution to extra-local actors at the village level. Whenever a water facility is delivered in any village, the extra-local actors have to work in collaboration with WUC.

The village water user committee is a formal institution unlike the informal committee discussed in Chapter Four that is voluntary and endogenous. The WUC comprises five members: chairperson, treasurer, secretary and two committee members. In both villages the secretaries are women (note: the WUC in Michunda is also defunct like in Kiganjo, discussed in Chapter Four). For all improved water facilities constructed by funding from District Local Government in Uganda and any other actor such as NGOs, a Community Based Management System is required inform of WUC (GoU, 2007). The WUC members are elected as guided by Uganda National Policy (GoU, 1999) and District Implementation Manual of the Ministry of Water and Environment (GoU, 2007). According to findings the WUC is supposed to plan and hold water meetings, implement agreed decisions of the users (community members), identify suitable land for drilling water facilities in conjunction with extra-local actors (government, NGO or donor) and resolve access matters. In addition WUC is supposed to ensure the following: user fees collection and proper utilization of community contribution towards operation and maintenance of shallow well or borehole, formulation and implementation of by-laws governing water

facilities and cleanliness around the water facility. The data I gathered from disbanded WUC committee members in Michunda show that they have been frustrated by the unnecessary breakdown of shallow wells that did not improve their water security. Committee members noted numerous tensions with extra-local actors on issues beyond water governance, however most of these issues were too personal to document. I also found that local politicians sometimes contribute to the demise of the WUC. For example, some politicians promise villagers that they will repair the borehole or shallow well pump, a promise which makes the WUC redundant and allows individuals not to take responsibility over their improved water sources.

Crucially, however, if NGOs are going to complement government action in establishing sustainable access to safe water, as per the water governance regime in Uganda, their interventions need to be effective. Kiganjo's story is particularly instructive in this regard. The village's first encounter with a water sector NGO was in 2001 when a local NGO used funds provided by a foreign donor to dig a shallow well.

Villagers in Kiganjo welcomed the intervention, but they also expressed grave concerns about where the well was placed. They believed that water from the precise location of the well would not be good for drinking or cooking. They were proved correct after the well was dug – they claimed the water was particularly salty.[9] Given the bad taste of the water and laundry stain, few

[9] Many people in this part of Uganda talk about water tasting salty; however chemical tests demonstrate that groundwater has a high iron content, which alters the taste (Richard Carter, Personal communication, 8 November 2012).

villagers used or indeed cared for the well and the pump was vandalized and parts were removed by thieves. The first critical intervention from water sector NGOs in Kiganjo was a failure.

That was 2001. Since then, no other improved water sources have been established in the village. Kiganjo's inhabitants remain reliant on open wells for their drinking water, with the attendant health implications. Not surprisingly, therefore, local people are sceptical about the usefulness of developing relations with NGOs, which is a dire verdict on Makondo's water governance regime. As one elder noted:

> "When [NGOs] came with their technologies, they told us to abandon our open wells. They said they kill us because they are not safe water sources. But their technologies are failing us; they often breakdown. Now shallow wells are all dry and down. That's why we don't abandon our open wells. Our problem is that [NGOs] have destabilized our cohesion regarding management of our open wells" (Personal interview, 24 February 2011).

Another community member expressed his lack of trust in the capacity of NGOs to make a positive difference:

> "…personally I don't care about them because *they do what they want*. In another village the same happened […] I wonder why they act in such ways. Our problems don't matter to them and we have lost trust" (Personal interview, 23 June 2011; my emphasis).

The case of Michunda shows that the village has benefited from NGOs more significantly than Kiganjo because these NGOs have installed three shallow wells: two in 1998 and one in 2007.

In addition, the NGOs have constructed and installed 42 RWH tanks of varying size and design. Above-ground tanks size range in size from 1000 to10,000 litres and below-ground tanks range from 10,000 to 400,000 litres. But these positive contributions from NGOs are unevenly distributed in Michunda, for example, 64% of RWH tanks are owned by the mission and staff employed by the church, school and hospital. The mission tanks have the capacity to store over 668,000 litres of water while general community tanks have the capacity to store less than 96,000 litres of water. During fieldwork, there was still one major RWH tank project under construction; this tank has the capacity of 400,000 litres on the secondary school land to enhance institutional adaptive capacity. My interviews with the project coordinator revealed that the local NGO has identified funding for institutional projects and not community-based water intervention projects as was the case previously. I argue this shift in delivery of water facilities may widen adaptive capacity gaps at the micro-scale in Michunda, and generally, Makondo Parish generally. Already, Michunda has the highest RWH tank count than Kiganjo.

As Bryant (2009) has described with reference to similar behaviour and practice of NGOs as 'self-serving organisations' (p. 1515), they can 'do what they want', as the respondent above notes. Indeed, the reality of development practice in a place like Uganda is that 'upwards accountability' (Dixon and McGregor, 2011) requires local officers to report on performance and deliver on specific targets in ways that sometimes undermine their intended achievements. For example, if one target is participation as measured by community contribution towards the cost of maintaining a well, upwards accountability can result in an NGO pulling out if targets are not met. Indeed, one NGO employee in Makondo Parish noted that,

> "we phase out our activities in a village if there is a lack of participation by people we want to help, because participation reflects commitment, and we have time limits to meet…" (Personal interview, February 8 2011).

As noted with regards to Michunda, however, participation is not always easy, especially given intra-village tensions such as generational differences; nor would participation necessarily be seen as a priority for villagers busy with household and other activities. In addition, as with the case of Kiganjo, NGOs do not always make effective interventions that generate trust and interest.

I argue that this incident in 2001 and the lessons people in Kiganjo have learned from it sheds light on the critical relationship between adaptive capacity to climate change in rural Africa and the water governance regime as a whole.

In practical terms development projects in Makondo Parish, and generally throughout Uganda, are often based on top-down planning which does not corroborate the micro-scale needs and conditions, local knowledge and decisions. Some researchers such as Kansiime (2012) underscore the significance of context-based adaptive capacity in Uganda. Kansiime (2012) insists that enhancement of adaptive capacity projects delivered by extra-local actors must take into account the community's perspectives, knowledge and resource endowment if they are to be sustainable.

As noted in the previous sub-section, during longer dry periods in villages such as Michunda and Kiganjo, people adjust their practices in ways that make more efficient use of the limited amount of water available to them. Individuals and communities have what Mortimore (2010) refers to as a 'platform' on which external actors can build. However, there is a mismatch between the local coping strategies and activities executed by extra-local actors and where there is a history of ineffective assistance from NGOs, as in Kiganjo, the interactions undermine adaptive capacity. At issue is the precise nature of the interface between villagers and external actors. The challenge is to *fuse* what villagers know – for example, about where a shallow well might be dug – with what outside 'experts' can provide; and also to ensure that outsiders make lasting and effective contributions to improve adaptive capacity. As Mortimore notes, 'increased dependency on state interventions or on external knowledge should be countered by an effective integration of local autonomy with state support and of local with science-based knowledge' (Mortimore 2010:141). Insofar as life in rural Africa inevitably entails numerous extra-local relations like those affecting Kiganjo, the danger is that those relations work against rather than for adaptive capacity.

5.4 Summary

This Chapter has used data collected in the field to contribute to an understanding of adaptive capacity at the village level in Uganda. The results reveal that people display intra-household and extra-household coping mechanisms. During the dry season – the period of the year when households experience the greatest water stress – households make minor but important adjustments that reflect a degree of flexibility in household water governance. However,

although there is some adaptive capacity that draws on knowledge of how to manage dry periods, this article argues that households in both villages remain highly vulnerable to climate change.

Moreover, the article has examined how the water governance regime in Uganda as a whole affects the adaptive capacity of people in the study area to manage their relations with water. The interplay between the locality and the water governance regime, specifically cash payment for the maintenance of water sources as opposed to in-kind payment, has brought new governance challenges that affect micro-scale collaboration, innovation and decision-making; challenges that impact on adaptive capacity. One worry is that NGOs sometime place too much value on deadlines – as one respondent made clear to me, "…we have time limits to meet" (Personal interview, February 8 2011) – than effectiveness, hence if they continue *doing what they want*, the risk is that their action will heighten vulnerability in places such as Makondo Parish. Effective interventions by extra-local actors need to fuse their knowledge with what local people know. In Mortimore's (2010) terminology, interventions need to build on the 'platform' provided by local adaptive capacity. Such a fusion of knowledge may contribute to efficient ways of delivering development programmes that enhance adaptive capacity of poor communities in developing countries. For example, strategies that attempt to address multiple limitations facing water governance at household and village levels, such as investment in shallow wells, small and large water carriage and storage containers, need to sensitively consider what local people already know and do if external interventions are to enhance future adaptive capacity of rural communities.

CHAPTER SIX

AGRO-PASTORALISTS IN MAKONDO PARISH, UGANDA

6.1 Introduction

My 'dynamic assessment' of adaptive capacity requires consideration of life within and between villages in areas such as Makondo Parish. The role of extra-local actors such as NGOs and government offer two of the most obvious ways to approach an examination of life between villages, hence they have been included in analyses in earlier chapters; but there is one other group of people in Makondo that deserves attention in this regard: agro-pastoralists.

Although there are only a few agro-pastoralist households in Makondo, they play an important role in the life of the area by caring for cattle, exchanging milk-based goods for cash or other products, and circulating a wide range of information about life in the area. They are important actors in understanding adaptive capacity because they spend the bulk of their lives in wetland areas in the valleys between villages. But in addition to this reason, the agro-pastoralists are interesting because they tend to be excluded from mainstream social and political life within the villages. Thus, I argue that to grasp how adaptive capacity to climate change emerges in a place such as Makondo, it is necessary to pay attention to the realities facing agro-pastoralists.

Alongside my various other activities in Makondo, therefore, and in recognition of their importance generally in the area, my fieldwork sought to conduct research with as many of these agro-pastoralists as possible, beginning with scoping interviews, continuing with participant observation during walks along wetland areas, some use of GPS to track their movements during a wet and dry period, and culminating in a small survey of 35 agro-pastoralists. This was difficult research because, as a minority group within Makondo, agro-pastoralists are cautious about whom they talk to. Nevertheless, I was successful in collecting a range of data, which I seek to introduce in this Chapter.

The data I use here first of all highlight some of the adaptive capacities evident among agro-pastoralists. As I discuss in more detail below, agro-pastoralists have accumulated years of experience in dealing with dry periods. They are, therefore, quite able to cope with the longer dry periods that climate models predict will occur as part of Uganda's interaction with climate change. This is not to suggest that longer dry periods will be problem-free for agro-pastoralists, but there is no doubt that they do have ways of making it through to the next rains. They have a degree of adaptive capacity, including some practices that have knock-on effects on the communities within which they operate and contribute.

However, the data I use here also speak to some of the constraints they face on a daily basis; constraints that are becoming increasingly difficult for them to surmount. Fundamentally at issue in the case of agro-pastoralists in Makondo is a set of developments that reflect broader shifts in

the life of rural Uganda. Specifically, my data highlight the increasing difficulties agro-pastoralists face in accessing pasture land and water for their animals. And of absolutely central importance in this regard is a process of 'enclosure' that seems to be gathering pace in Makondo and elsewhere in Uganda. As I discuss later in the chapter, land acquisitions have reduced the amount of pasture land agro-pastoralists can access and introduce new concerns about their animals trespassing on such land. In addition to this consideration, the agro-pastoralists express serious concerns about other changes occurring around them, including the growth of brick-making businesses and market changes that reduce demand and prices for milk they have grown accustomed to selling in villages in Makondo Parish.

The rest of the Chapter is organized as follows. In section 6.2, I first explain in more detail why my dynamic assessment of adaptive capacity included a consideration of the role of agro-pastoralists. At issue here is the need for an assessment that can try to capture the realities faced by minority groups that might otherwise be overlooked when conducting research at the village-level. In my work, for example, the most prominent people in each village in which I worked were village councillors and other active men and women, but I realized that my working with them alone risked neglecting some actors who never attended village meetings but who were nevertheless playing an important role in the life of the village. Foremost among them in Makondo were the agro-pastoralists who moved cattle (and therefore wealth) around and between the villages.

Following a discussion of the methods I used to research the role agro-pastoralists play in shaping adaptive capacity, I then introduce my findings, a part of the Chapter which I divide into two sub-sections. The first sub-section highlights their adaptive capacities: that is, what do they do to cope with longer dry periods and how do their actions contribute to the broader adaptive capacity in Makondo? The second then looks at the mounting constraints they face in their daily lives, constraints that undoubtedly undermine their adaptive capacity. Here I also discuss some broader issues regarding the direction of agricultural policy in Uganda that help explain the changes occurring in Makondo.

6.2 Why study agro-pastoralists as part of a dynamic assessment?

As I have explained throughout this doctoral dissertation, trying to understand adaptive capacity to climate change in a place such as Makondo requires attention to micro-scale practices within households and between individuals within villages. The role of extra-local actors such as NGOs and government must also be included. Methodologically, this raises challenges which I have tried meet by adopting an approach I refer to as a 'dynamic assessment.' I have sought to combine ethnographic research with a type of participatory GIS that allows individuals to explain their surroundings and outline the range of adaptive capacities they practice to cope with seasonal variations in temperature and precipitation. Very soon after I began the research, however, I noticed that one group of people in Makondo – agro-pastoralists – were not attending meetings I organized. Upon asking about agro-pastoralists, I found that they are considered a minority group in Makondo and are frequently and purposefully excluded from community

meetings and other events. The background to this situation deserves brief elaboration here. Nomadic or semi-nomadic agro-pastoralists are found all across Uganda and the wider region, however there has been a broad process of sedentarisation in the twentieth century, with growing numbers of agro-pastoralists opting to practice mixed crop-livestock farming (e.g. see Wurzinger et al 2008). Government policy has encouraged sedentarisation (Wurzinger et al., 2008). The state claims it is easier to provide services to settled communities, including veterinary services to cattle, which helps control diseases such as bovine tuberculosis (Inangolet et al., 2008). Recent policy programmes such as the Programme for the Modernization of Agriculture (hereafter, PMA) are also heavily oriented towards settled cattle farmers rather than (semi-) nomadic agro-pastoralists (Butler and Gates, 2012). Indeed, as noted by Behnke Jr (1985), government policies such as PMA describe nomadic agro-pastoralists as 'backward' and practising a way of life that needs to be modernized. Rather than (semi-) nomadic agro-pastoralism, then, the government increasingly favours a form of supposedly modern cattle ranching in controlled herds supported by veterinary services and intended to supply distant urban commercial markets instead of local subsistence (Butler and Gates, 2012).

In Makondo, the case of agro-pastoralists reflects these broader changes in Ugandan society. Agro-pastoralists – who tend to belong to the Munyalwanda, Munyankole, Mukiga and Munyolo tribes, in contrast to the Baganda people in the area who constitute the majority – are often referred to as backward, or out of touch with modern life. They are viewed with suspicion and, with literacy rates improving among many households in the Parish, the mostly illiterate agro-pastoralists are effectively excluded from village life. That agro-pastoralists spend all day with

their cattle and are unable to attend village meetings held in daytime also contributes to their exclusion.

The problem their exclusion raised for my research was that my dynamic assessment required trying to understand as much as possible about the lives of people in Makondo and how they might deal with longer dry periods, hence it would be problematic if my approach was unable to take into consideration minority groups such as agro-pastoralists. This was especially the case because the agro-pastoralists were also recognized and indeed discussed by community members as 'mobile banks' because their cattle store wealth, which has consequences in a poor area such as Makondo.

Viewed in more general terms, the case of an excluded but important minority such as agro-pastoralists in Makondo speaks to some of the challenges facing researchers interested in adaptive capacity in Sub-Saharan Africa. As I have noted in earlier Chapters, assessing adaptive capacity entails spending time in a place, not simply (although, in itself, it is certainly difficult) conducting a social survey of respondents. But even if a researcher can spend sustained time in a place, there must still be some recognition that excluded groups exist and the researcher must try to then conduct research with those groups, although obviously in an ethical manner. The challenge is that adaptive capacity is about the sum of practices and indeed the nature of those interactions, hence excluded groups play a role and need to be included in any assessment of how a community might manage the new difficulties posed by climate change.

Feminism is one major strand of theory that explicitly recognizes this general point (Delyser et al., 2010). As such, approaches such as participatory rural appraisal (PRA) seek to ensure that women are included and given due opportunity to participate in research projects. The same principles apply to other situations in which villages are constituted by different occupational groups. The mistake is to imagine villages in Sub-Saharan Africa as homogeneous communities divided only by demographic factors such as age and gender. Especially given inter-ethnic mixing and indeed migration and asylum from war (Butler and Gates, 2012), rural life in Sub-Saharan Africa can often be characterised by quite intense social diversity and domination and exclusion.

In the literature on adaptive capacity in Sub-Saharan Africa, however, forms of inequality or exclusion that might exist at a local scale have not been given much explicit attention. As a consequence of this oversight in the literature, there is no guide to dealing with minority groups when trying to assess adaptive capacity. In the following section, therefore, I outline a practical, realistic, and ethical methodological approach which made sense to me at the time, took into consideration the daily realities of agro-pastoralists, and which generated some success.

6.3 Methods

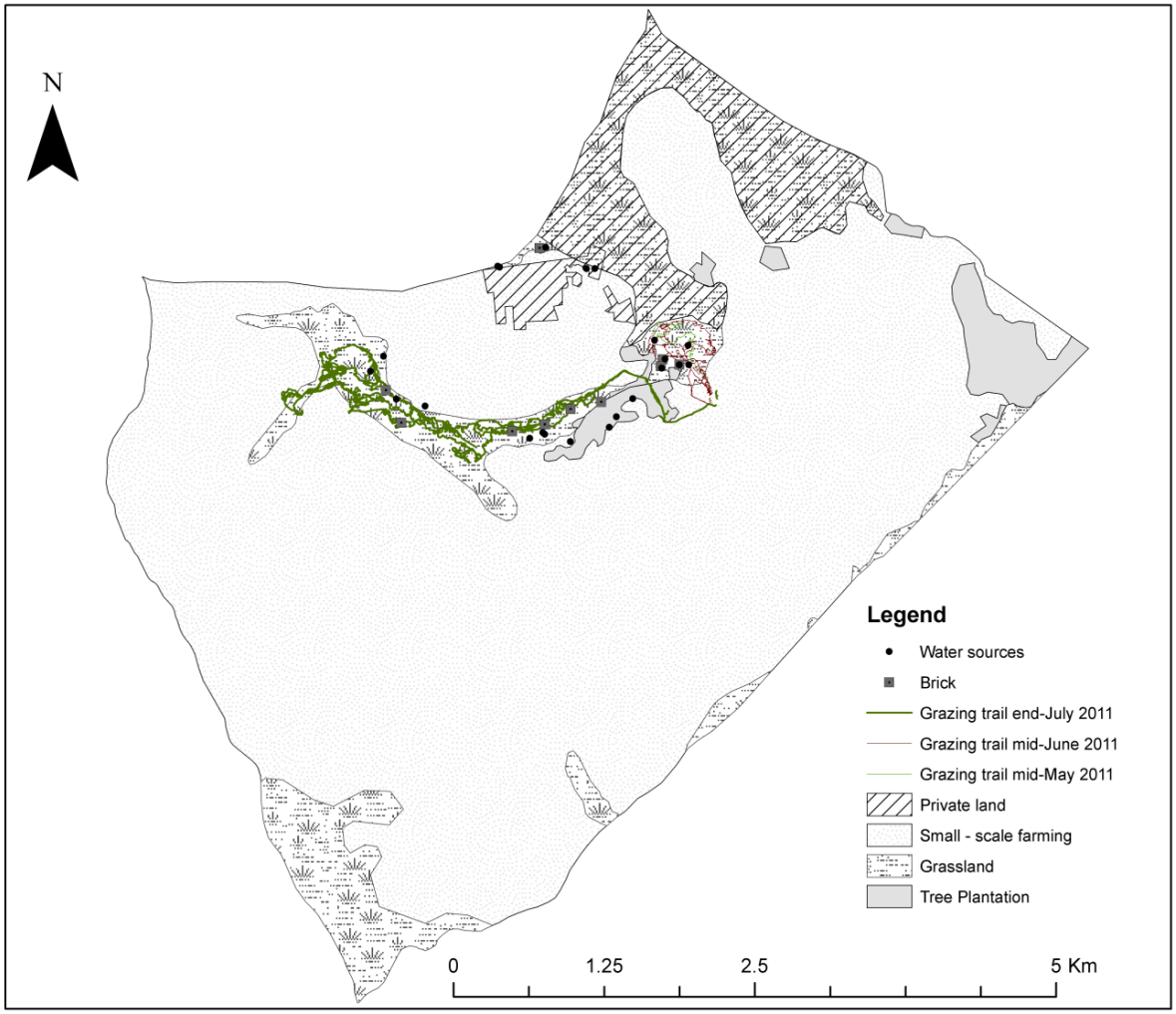
My method was a ‘dynamic assessment’ which I have described in Chapter Three of this dissertation. I used the dynamic assessment to help reveal elements of the agro-pastoralists’ adaptive capacity to climate change. My overall approach was conducted in three main stages. The first stage lasted three months (February, March and April, 2011). I began this stage in

Kiganjo and Michunda by spending time with three agro-pastoralist households. My aim was to gain an understanding of their lives, before examining their adaptive capacity and the constraints they faced in both the villages and beyond. I began exploring their understandings of water and pasture management by asking questions about how they move and care for their cattle. From these initial meetings and discussions, I found that agro-pastoralists had to move far away to where there was pasture and water. What I wanted to do was try to capture their movements to identify times and spaces where they met up with the wider community, that is, to identify how they manage to negotiate their interactions with others in Makondo.

In a second stage, during the wet season of March-May 2011, I tried to gather detailed information about where agro-pastoralists go to get water and pasture. My approach was to use hand-held GPS units. I introduced some agro-pastoralists to these units, demonstrated how they work and how they could then be used to generate maps on my laptop computer. I also devised some 'crash training' on using the handheld GPS units, the Garmin Etrex Vista HC hand held GPS. This unit has a trip computer which records the accumulative trip information as the user moves, such as the number of points or events in the track, the date and time when recording started, the total time elapsed while the movement was recorded, the total length of the track, and the average speed of the moving person along the track. I preset my GPS units to capture these variables before I demonstrated how to use them to the respondents. The data I collected from this exercise helped me visualize the movements of agro-pastoralists and identify 'flashpoints', that is, moments when their movements entailed negotiations and dilemmas that I was able to ask them about in an interview setting. The data also enabled me to add their movements to the

overall GIS database I made of the Parish. The first impression of the distribution of agro-pastoralists is shown Figure 6.1. This map acted as baseline data about the range of water sources used by the agro-pastoralists. However, this data also left many questions regarding agro-pastoralists' experience with animals and the relationship of enclosure to water and pasture. In subsequent stages of the research, then, I sought to reveal more about their interactions with the community.

Figure 6.1: Land use and grazing arrangement



I was successful in having five agro-pastoralists taking hand-held GPS units to record their travel distances, times and average speeds, first during the March-May 2011 wet season and then second during the June-August 2011 dry season. The GPS recordings revealed how they moved and where they went, and these data allowed me to ask the respondents about what was happening during their time with the herd. In this regard, the data from the GPS units required ground observations, which entailed qualitative research with the agro-pastoralists. During the dry period in May-July 2011, I further explored their practices on the ground with some of the agro-pastoralists. In this stage, and following the success of the work in the second stage, some of the agro-pastoralists agreed that I could accompany them as they walked. This allowed me to observe their adaptive strategies. Again, therefore, ethnographic methods complemented the GPS-assisted research and this enabled me to uncover some of the dynamics of adaptive capacity pertaining to cattle, the herders, and their interactions with resources. Alongside this work, I also recorded ten semi-structured interviews with some of the agro-pastoralists.

In the third and final stage, July-August 2011, I managed to get 35 agro-pastoralists to complete a short survey with a view to understanding the anticipated future for cattle keeping. This questionnaire addressed their perceptions of water and pasture scarcity, climate change, their coping mechanisms, their connections within and without the community, and what they anticipated would be the future of cattle keeping.

As a whole, the data collection for this study was very difficult. The main challenge was that land grabs have been occurring in the study area, which made most agro-pastoralists anxious

about my association with them and especially my attempt to use GPS to track their movements. In addition, as a minority group, the respondents were quite wary about my research. I was even labelled ‘a spy of government’ and ‘a prospective land buyer’. I tried hard to change their image of me by contacting agro-pastoralists through some individuals they trusted in the community and talking with them and gradually building up their trust. The agro-pastoralists often had special demands, such as asking to see what was inside the GPS. I therefore had to open the battery cover for them to see inside. I was successful in establishing a good rapport with enough of the agro-pastoralists and I therefore secured their consent by guaranteeing that my research would conform with my university’s ethical guidelines, such as that any data I used would protect their privacy.

6.4 Findings

In this section I introduce some of my findings regarding agro-pastoralists and their adaptive capacity to cope with climate change. At issue here are their adaptive capacities but also the constraints under which they operate. Without any doubt, agro-pastoralists have developed coping mechanisms and strategies to manage dry periods when water becomes in short supply and tensions increase regarding how water is used in the area. But as my findings also indicate, agro-pastoralists face some daunting challenges, some of which are leading them to consider changing their circumstances. Because climate models predict longer dry period, my focus in the following discussion is on the experience of agro-pastoralists in the dry season, although I also make reference to how those experiences contrast with periods when there is sufficient rain.

6.4.1 Agro-pastoralists adaptive capacities and their importance in wider community

With regards to the adaptive capacities of agro-pastoralists, my research revealed a range of practices that help herders cope with dry periods. I identified five key areas in which some of their practices signal a degree of adaptive capacity: knowledge, mobility, cooperation and sharing, culling the herd and diversification

Knowledge

I found that agro-pastoralists' local knowledge about water in the wetlands is crucial for coping with climate change. They therefore draw upon their micro-scale knowledge of the wetland areas, as one respondent noted:

> "We have explored the wetland and we know where water springs can be found. And we dug our wells there […] We know where there is […] fresh water around the villages…." (Personal Interview, 27 April 2011).

During my grazing experience with some herders (May and June), we counted 33 open wells that had water. My observation of the wells showed that water in the wells lasted differently: almost one-third of the wells that were dug in the 1950s were observed to keep water till the next rainy season while those wells dug between 2000 and 2009 within the wetland only kept water until the end of July. Herders mentioned that the more recent open wells run dry from mid-July depending on the characteristics of the rainy season, for example, if rains are erratic and low or if a drought occurred they expected them to dry rapidly or have no water at all. However, in a good rainy season water can remain in the open wells until the next season. My assessment of recent

wells in the grazing field was that cattle walked into the open wells to drink water which contributes to sedimentation and rapid drying.

When the dry season intensifies, herders used their local knowledge about the wetland to decide where to dig a new well. I specifically observed two agro-pastoralists during the dry season digging two new open wells that were later on used to water their cattle in Misaana village. They dug the wells deeper than those found in communal grazing areas. The two agro-pastoralists deployed additional management techniques at the open wells as compared to the shared water sources I counted in the wetland. These wells have clay troughs next to them. I watched the herders lifting water from deep wells into troughs for their cattle to drink. Respondents indicated that they too use clay troughs to water their cattle because it eases the burden of scooping sediments if animals were allowed to walk into the wells and drink the water. For example, Wamaakuba open well in Kiganjo village is owned by an agro-pastoralist. The owner has a clay trough next to the well that he begins to use from mid-June as one way of conserving water so that it lasts long during the dry season. He practiced conservation techniques because he perceived July and August as severely unmanageable in terms of water. I argue that without this knowledge, many agro-pastoralists would have not survived 37 years of cattle keeping in Makondo.

Mobility

Historically, agro-pastoralists would have moved far and wide throughout the wetlands during the dry season. Such mobility is still one way that many of them try to cope with water and

pasture scarcity, with 55% of the respondents in my survey saying that they moved to other parts of the parish when local water and pasture was exhausted. In doing so, they drew upon family networks such as brothers, uncles and also 'good' friends outside Makondo, even in exceptional circumstances moving as far away as Masaka (54km from Makondo).

Within Makondo there are what we might refer to as 'micro-scale' movements. My data revealed some aspects of these movements within the wetland areas (Figure 6.1). The GPS used in this research recorded the movements of a herd from their kraal to regular grazing fields in the wetland (Kibuye-Michunda wetland). The micro-scale movements are some of herders' coping mechanisms. Figure 6.1 shows the micro mobility of herders on the grazing field (during May to July). These movements demonstrate a degree of flexibility across space and time that helps them cope with water and pasture variations.

GPS observations from one herder showed further variations in mobility during different seasons. These GPS results also showed that mobility can vary between and within seasons: for example, one herder in 2011 moved 4.8km in May, 9.3km in June, 14.6km in mid-July and 19.3km at the end of July. I observed that adjustments in movements depended on local knowledge and experience regarding pasture and water availability in the wetland. One day when I participated in grazing cattle, I counted 15 herds grazing together for almost 10 hours (from 6.30 am to 5.30 pm). A brief discussion with herders on the ground corroborated GPS observations about micro-scale movements and increasing trends of walked distance as the dry season intensifies and pasture becomes problematic. During one interview with agro-pastoralists,

I wanted to understand 'how agro-pastoralists cope with pasture and water shortages?' One of the respondents said:

> *Agro-pastoralist*: "Now it is wet season [March-May], I graze near my house. There is pasture and water. My cows can feed and drink. During June all grass will dry and there will be dust here. We share this little pasture with colleagues from neighbouring villages. Our village doesn't have enough grazing land, so, from June until next rainy season [September-December] we will all graze in Kibuye and Michunda wetland…"
>
> *Me*: Last time [10 March 2011] you told me that you couldn't move to other places to find pasture and water. How is this possible?
>
> *Agro-pastoralist*: "Where we graze during the dry season, there is part of the wetland that is still open to everyone. My job is to ensure I find the best way to get there without trespassing on people's assets and work with my friends on the ground…" (Personal Interview, 25 July 2011)

Such movements were not possible for all, however. For one thing, only Ankole cattle are capable of walking such long distances to access water, but most Baganda agro-pastoralists stocked crossbreed (crosses between Ankole and Friesian) that are not as adaptable to long distances as pure Ankole cattle. In addition, 17% of the respondents (specifically of the Muganda tribe) said that they shared pasture locally but never migrated to other places outside Makondo because they are not nomadic. They commonly disassociated themselves from agro-pastoralists who were formally nomadic pastoralists by saying "we are not wanderers" (i.e. nomadic). I

observed that they kept fewer cattle than the agro-pastoralists and were often feeding their cattle with banana peels to supplement grazing in the evening. Some would also tether their herd in the wetland, a common practice mainly among agro-pastoralists with less than ten cattle.

The Baganda confined their cattle in small 'communal' grazing pockets and watered their animals late in the afternoon after grazing. I observed that their cattle shared open wells with people. For example, in Michunda, Moses [all names have been changed] had four cattle which he always tethered. Each day he went out in the village and to nearby restaurants to fetch banana peels to feed his herd. He also used the nearby open well called *Kidabada* to water his cattle in the evening. I observed his animals walking into the well to drink water, a common practice throughout Makondo.

In summary, I argue that mobility enables agro-pastoralists to survive seasonal fluctuations in Makondo, especially for those with herds of more than ten animals and who did not have access to banana plants. There have been numerous changes in the grazing landscape, such as longer grazing times, greater distances travelled at the grazing front, and new demands to share water with people and other cattle.

Cooperating and sharing

I found that cooperation and sharing resources acts as a coping mechanism to cattle survival and to peoples' well-being against extreme climatic event. Relatives are particularly called upon by agro-pastoralists to share information and knowledge regarding diseases; exchange bulls for

breeding and re-stocking. Respondents belonging to the Munyalwanda, Munyankole, Mukiga and Munyolo tribes who were originally nomadic pastoralists particularly emphasized the importance of these alliances.

Cattle keepers strongly believed that a "herd is equal to cows" and therefore sharing female animals was considered as means of sustaining agro-pastoralism. Once the cows give birth they were returned to the original owner. A beneficiary keeps the first calves as a new herd. An interview with one agro-pastoralist in Kiganjo revealed that at times the beneficiary can keep both the cows and second born calves in one kraal but both the second calves and the mother cow belong to the original owner. I also found that the Munyalwanda, Munyankole, Mukiga and Munyolo tribes kept both their cattle and colleagues' cattle. Another benefit of cooperating was taking turns to be in charge of grazing. For example, herders would graze in turns of 3 or 7 days; during their free days they could perform other activities such as cultivating crops or vending milk.

I also found that some coping mechanisms depend upon cooperation between the rich and the poor. During key informant interviews I found that two brothers from the Munyalwanda tribe depend on cooperation with a landlord in Makondo. Since 1995 they have been keeping cattle for this landlord in order to benefit from use of his portion of wetland and upland. At the time of interview they were keeping 12 cattle in their herd belonging to this landlord. The landlord has an area of wetland with one perennial open well that was dug in 1950s and which is used to water animals. They said "we have a place to graze cattle but the land belongs to one rich

landlord. My brother negotiated a deal to take care of his cattle in 1995. We entirely depend on this cooperation […] (Personal Interview, 17 June 2011). My survey results also showed that 5.71% of other agro-pastoralists have connections with private land owners but, these respondents indicated that they pay the landlord either in-kind or in cash to access water when the dry season intensifies or drought occurs.

Agro-pastoralists also cooperated with local leaders in their villages in order to resolve disputes, especially when cattle trespass onto other people's fields or if they used someone else's water source. Some agro-pastoralists (7.2%) also had relations with livestock management services from the local government as well as from some private service providers. Most services focused on disease diagnosis and treatment and less on water access. The service providers themselves favoured working with agro-pastoralists that stocked crossbreed cattle, as promoted by government livestock projects. Agro-pastoralists in Kinyumbakimo and Kibuye villages connected to such projects were advised to have an underground water reservoir, which they stock by harvesting 1000 litres of rainwater, enough to last two months for their cows. However, respondents noted that this underground water was also used for domestic chores, such as washing dishes and laundry.

In summary, a wide range of cooperative relations generate coping mechanisms for agro-pastoralists to draw upon. These relations reflect the close connections agro-pastoralists have with each other and with the wider community. They are intent on managing fluctuations in water availability and draw upon their networks to achieve this aim.

Culling the herd

In addition to their knowledge about the wetlands, their capacity to move around, and their cooperative relations, I found that agro-pastoralists also try to cope with dry spells by culling their herd. Agro-pastoralists (86%) mentioned that the potential for live cattle sales tends to increase during the dry season. The respondents associated the dry season period with greater deterioration of pasture and water, increased incidences of certain diseases and occurrences of sudden death of animals than during the wet season when the pasture and water are available and lactating cows produces relatively enough milk (about 2L per day).

Agro-pastoralists lamented that droughts are extremely unmanageable and can be catastrophic to them. One agro-pastoralist lamented that "when drought strikes hard, it is not me to decide on which animals to keep. All of them may die. You accept what remains. I don't have a clear answer on this because a disaster is disaster…I have control during normal dry season when I cull usually four to six animals per year…" (Personal Interview, 24 June 2011).

Thus, 60% of agro-pastoralists (especially those with more than 20 animals) mentioned increased sales of live animals during the drought years compared with normal dry seasons. Also, mortality of animals were claimed to increase and most of them (71.43%) highlighted that their herd size could be reduced within first drought, for example, during the 1999/2000 drought most respondents claimed to have lost their herd and some had to restock.

Additionally, I found that agro-pastoralists embraced specialized knowledge to cull some animals they perceived to be unproductive. 80% of agro-pastoralists adaptive action revealed that as herders moved with animals in the wetlands, they were also continually observing an array of issues on individual cattle such as difficulties in walking due to old age and poor health. Such animals were spotted for culling. The other 20% of agro-pastoralists indicated that they observed and marked cows with poor production performance (e.g. those with high abortions or gave birth repeatedly to males) and infertile animals.

Their overall conclusion, then, was that culling is unavoidable during drought: "during drought we sell more cattle to keep few. We sell even our cows because they can't become pregnant. We need money to buy food among other essentials. We try to keep some money to restock once conditions improve, although it's hard. If we sold two cows, we may manage to buy one because when weather conditions improve prices of cows increase. Our problem we usually sale our cattle at a give away price to avoid total loss…" (Personal Interview, 11 June 2011).

However, agro-pastoralists mentioned that sale of cows is the last option. I understood from their explanations that 'sequencing' was key before a live animal was sold. For instance, they first sought sales of milk to the wider community in order to earn money to buy cheaper forms of calories such as maize grain. Secondly, they would consider selling sickly animals when lactating cows ran dry and only then would they move on to sell heifers and old members of the flock, bulls, and lastly cows with production limitations.

Diversification

My ethnographic study of minority tribes (in Makondo Parish, the minority tribes are the Munyalwanda, Munyankole, Mukiga and Munyolo people) revealed that the Munyalwanda women were mostly responsible for household food security. I specifically observed the Munyalwanda women because they were found in my two study villages of Kiganjo and Michunda. They tended newborn calves around the homestead. The Munyalwanda married women spent much of their time indoors making local butter, gee and yoghurt that was sold alongside fresh milk. Each day the women kept some milk, yoghurt and gee for their own domestic consumption and sold 500g of butter at USh5000 and 500ml fresh milk at USh500. Unlike butter, milk was sold daily depending on the yield. In addition, I observed that milk, butter, yoghurt and increased meat availability during the dry season provided a source of adaptive capacity to the community in terms of nutritional security. Such sales of milk and animals increased integration of these minority tribes in the wider community. But these sales also enabled many women in agro-pastoralist households to invest in containers for storing water and transporting milk. The same income was used to buy food supplies mainly bananas, cereals such as maize and millet to supplement household food requirement among other needs. I also noted that many women made mats that were sold to diversify household income.

Since milk yields varied across and within season, most respondents mentioned that they depended on crops during the dry season when milk production was lowest and the requirement for labour energy to tend herds is at its peak. Male respondents mentioned that lower milk production was compensated by higher sales of live animals during the dry season.

Some agro-pastoralists, in particular of Muganda tribe, were not committed to the local milk trade and butter making. The Baganda agro-pastoralists claimed that their cattle were for income via the sale of live animals and domestic milk supply. Their different stance with respect to culling of herds reflected their ownership of well-established banana plantations, something the Munyalwanda tribe tended to lack. These latter agro-pastoralists only used about one-eighth of their homesteads for growing crops and instead left the vast portion of the land to grass and shrubs.

6.4.2 Constraints facing agro-pastoralists' adaptive capacity in Makondo

The focus in this sub-section is on the constraints that limit the adaptive capacity of agro-pastoralists in Makondo. I discuss how processes of land enclosure and competition over land use among non-private users such as brickmakers, foresters, and domestic water collectors affect herders in their efforts to cope with dry periods.

Processes of land enclosure

So-called 'land grabs' have emerged to become an immensely controversial topic in Uganda (e.g. see Mastiko [2012] and FOEI [2012]) as well as more generally in Sub-Saharan Africa (e.g. see Akram-Lodhi, 2012: 126). According to Akram-Lodhi (2007), these land grabs entail a process of 'enclosure', in which land in an agrarian-based economy is purchased for the purpose of commercialization, such as for production of export crops. It is well known that such a process can create new levels of social inequality and exclusion regarding resource utilization, particularly around access to water. Because they require access to a wide range of land,

enclosure has a particularly problematic effect on agro-pastoralists. If land parcels are privatized then agro-pastoralists encounter enormous difficulties in moving cattle to and then through the wetland areas where water is available. In Makondo Parish as a whole, agro-pastoralists reported grave concerns about the removal of communal pastureland, with 71% of the respondents in the survey I conducted stating that local leaders at village level are involved in land transactions with wealthy buyers, many of whom are not from Makondo. The outcome is that only 41.5% of the 629.23ha of pastureland in Makondo is freely accessible to agro-pastoralists.

Given the centrality of this issue to the adaptive capacities of agro-pastoralists, I will now discuss enclosure dynamics on the ground as experienced by herders in my study. My data indicate that new landowners have become an obstacle to herd mobility through the construction of 'fences' (often simple barriers or signposts indicating that the land is privately held) as well as the imposition of fines if an animal trespasses into those private parcels. Such fines are a traditional way of trying to manage disagreements and conflicts in Makondo but some private landowners have also turned to the Police for assistance in collecting fines, a move which indicates the growing presence of the modern state working to protect private landowners in Makondo. My interviews with agro-pastoralists highlighted this issue, as one herder made clear:

> "Two weeks ago my two cows crossed the fence and they were detained by the landowner. The matter was reported to the police. When rich people's property is encroached, the police are active. I was fined UGS300, 000 and I've just paid to redeem my two cows. Life can be hard for us poor *balaalo* [herders] nowadays" (Personal Interview, 17 June 2011).

The construction of fences and punishment via fines act as traps that herders must avoid, which fundamentally complicates their lives. As another herder noted, the threat of facing fines influences his actions on the grazing front:

> "...managing a grazing herd needs taking responsibility and quick decision making. I must look after other people's properties […] Failure to do so may results in loss of income through fines" (Personal Interview, 21 July 2011).

In drier months in particular, fear of fines makes the management of a grazing herd an arduous task for herders. Because cattle can notice the difference between the quality of grass on communal and private land parcels, herders struggle to prevent their cattle from crossing onto the better pasture on private land. As one herder states:

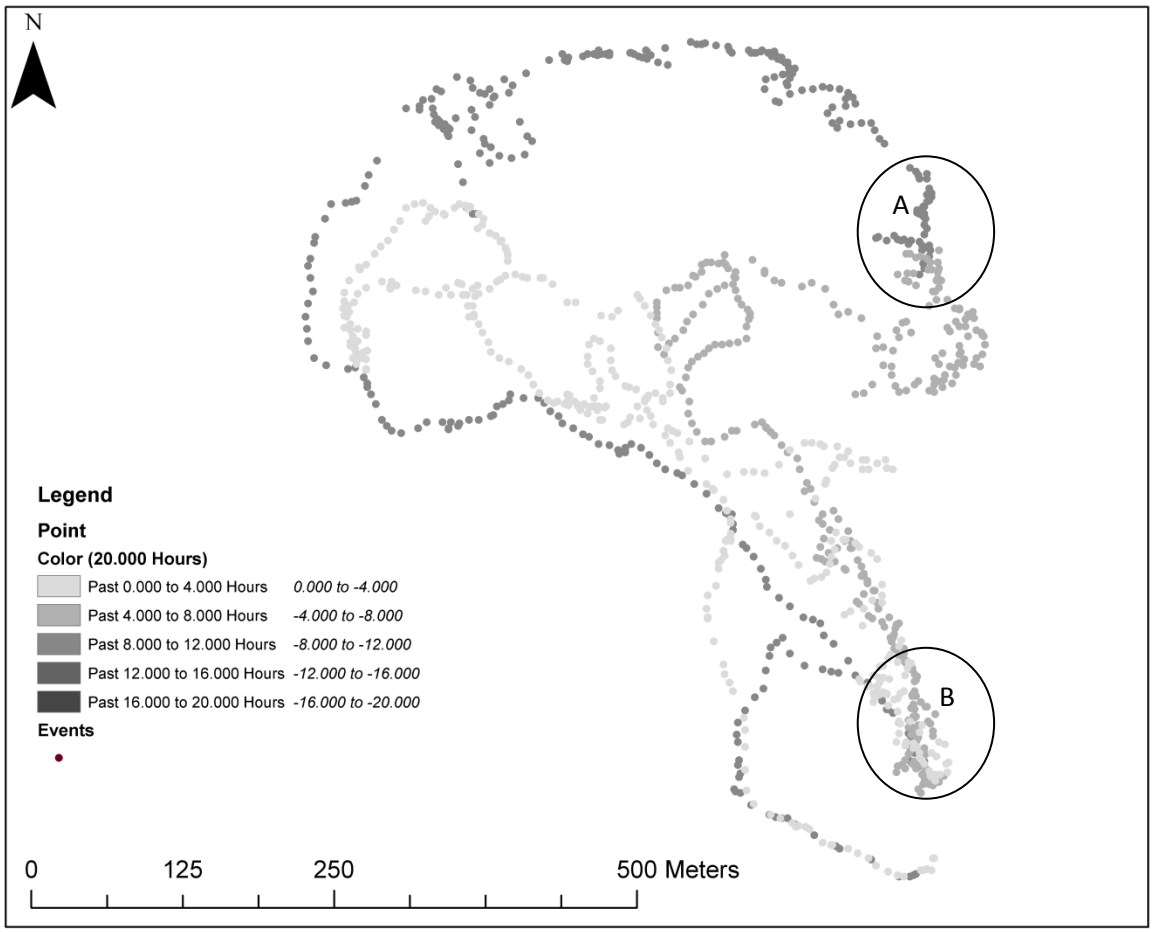
> "I struggle to keep cattle away from private pastureland. Cattle often graze facing the direction of private pastureland because there is good pasture. Cattle want to graze there [private pastureland] where [there] is good pasture" (Personal Interview, 21 July 2011).

Moreover, because they only have access to around 40% of the pastureland in the Parish, herders are increasingly confined in small 'communal' grazing pockets where the cattle graze on a daily basis during the dry season. The herder therefore made the point that grazing was more tiring in those drier months because cattle grazed faster and herders had to move faster too, making them get thirsty and hungry more quickly. During participant observation with herders, I also found the work to be immensely challenging during the drier months. At every stop and turn the herders had to shout and/or whisk the animals from crossing the boundary. Thus, as one herder

said to me, “it is a zigzag and an unplanned movement. If you sit down and fall asleep you might find that cattle are deep in private pastureland”.

The data I collected from GPS units the herders carried for my research visualize and charts these difficulties (see Figure 6.2). The data on movements reveal interesting patterns regarding the herders’ practices and actions on the grazing front. The first pattern is the very slow movement of herders, which is punctuated with short stoppages (mainly outside the perimeter of the grazing herd). This pattern illustrates how enclosure increases their workload in the dry season.

Figure 6.2: Number of events and micro level mobility (zoomed from Figure 6.1 legend 17 June 2011)



A detailed analysis of movements in Figure 6.2, during every four hours indicates that mobility is overlapping, for instance spot B in the figure above shows that every four hours a herder came to this spot. I observed that a herder carried out the same action at the same position at different times without himself realizing. My field observation showed that such spots were usually adjacent to good pasture in private land.

The second pattern is the frequency of events or actions which show the extent to which herders were moving to stop their cattle from trespassing. These movements represent the density of actions performed by a herder which is symbolized by clouded points in the map. The clouded points (spots A and B in Figure 6.2) are 'hotspots' next to good pasture in the private pastureland. I observed that hotspots presented points of struggle to stop cattle from trespassing. The herders could walk to other places but frequently came to whisk fast moving animals in the hotspots.

Table 6.1: Movement details of a herder during the wet and dry seasons

Month	Start and end time	Duration (hours)	Number of events	Average speed (km/h)	Distance walked (km)
May	8.30am to 5pm	7	766	0.7	4.8
June	8am to 5.30pm	11	1057	1.4	9.3
Mid-July	7am-4.30pm	9.5	2148	2.0	14.6
End-July	6.30am to 5.30pm	11	2266	2.0	19.3

Table 6.1 presents additional data from the GPS tracks of one herder. The data show that the situation shifted abruptly from the wet season in May to the dry season in June and July. During June and July, as the availability of pasture declined and the grazing trends changed the grazing duration increased from 7 to 11 hours and the number of events increased from 766 in May to 2266 by the end of July. The herder was moving much faster and more often, plus the total distance he was walking each day increased from 4.8km in May to 19.3km by the end of July. Life for this herder became much harder as July progressed, when grazing started as early as 6.30 am and lasted until 5.30pm. Moreover, the average grazing speed increased to 2.0km/h because

cattle were grazing grass on very bare ground. This GPS recorded data corroborates with what I experienced when I participated in grazing: herders were constantly moving or whisking cattle in July, desperately trying to keep their herd from straying onto private land. Overall, then, these data demonstrate that the workload performed by herders during the dry season constrains their adaptive capacity.

I also noted that other agro-pastoralists returned home very late in the evening during the dry season, with some herders closing their kraals at 9.30 pm. The next morning, moreover, herders were out milking their cows as early as 4.30 am before taking them to graze. They indicated that they could not do other jobs such as ploughing their gardens because of fatigue. One herder said, "…because I'm up very early to milk my cows. After that I come to graze cattle. I keep walking. I am thin and weak. I can't do other jobs tomorrow…." (Personal Interview, 17 June 2011).

During participant observation with herders, I also noted that cattle were grazing much faster than they had been in May. They were generating much more dust because the animals were grazing in the same places day after day. In other words, as July progressed, the herders were reaching the limits of their land carrying capacity, resulting in some areas in erosion from overgrazing and overstocking. But this outcome only made the cattle graze faster because there was no grass on the ground, which made it harder again for herders to keep their cattle from the longer, more luscious grass on private land parcels within the wetland areas.

Another factor here was the high prevalence of cattle pests and diseases because, although some agro-pastoralists could afford to treat their animals with medicine for respiratory infections and to minimize the effect of pests, many others could not, which meant their close proximity to one another enabled pests to move from one animal to the other. Thus, in one conversation I had with a herder he told me that he was treating his calves to protect them from flies and ticks:

> *Me*: I saw you treating your calves on Tuesday. What were you treating your animals for?
>
> *Agro-pastoralist*: "…I do this every season to protect my cows from flies and ticks. My anxiety is, even if I can treat my cows [the] other herders don't, yet we all graze in one place. Tomorrow we will all meet there [a grazing field where I had met him before]. What's my benefit of doing this? …"
>
> *Me:* Why is this so?
>
> *Agro-pastoralist*: "…we graze cattle in one place that's why my cows are sickly and suffer from ticks and flies..." (Personal Interview, 30 July 2011).

As a result of these changes and conditions in Makondo, I argue that the possible adaptive capacities of herders are severely constrained. Enclosure is a key reason why traditional cattle keeping practices, especially those which rely on mobility, are on the decline.

<u>Conflicts with other resource users</u>

Not only are processes of enclosure proving difficult for agro-pastoralists in Makondo, there are some other changes that have been complicating their existence. In particular, across the wetland areas where herders take their animals to feed, there are numerous other land uses that compete

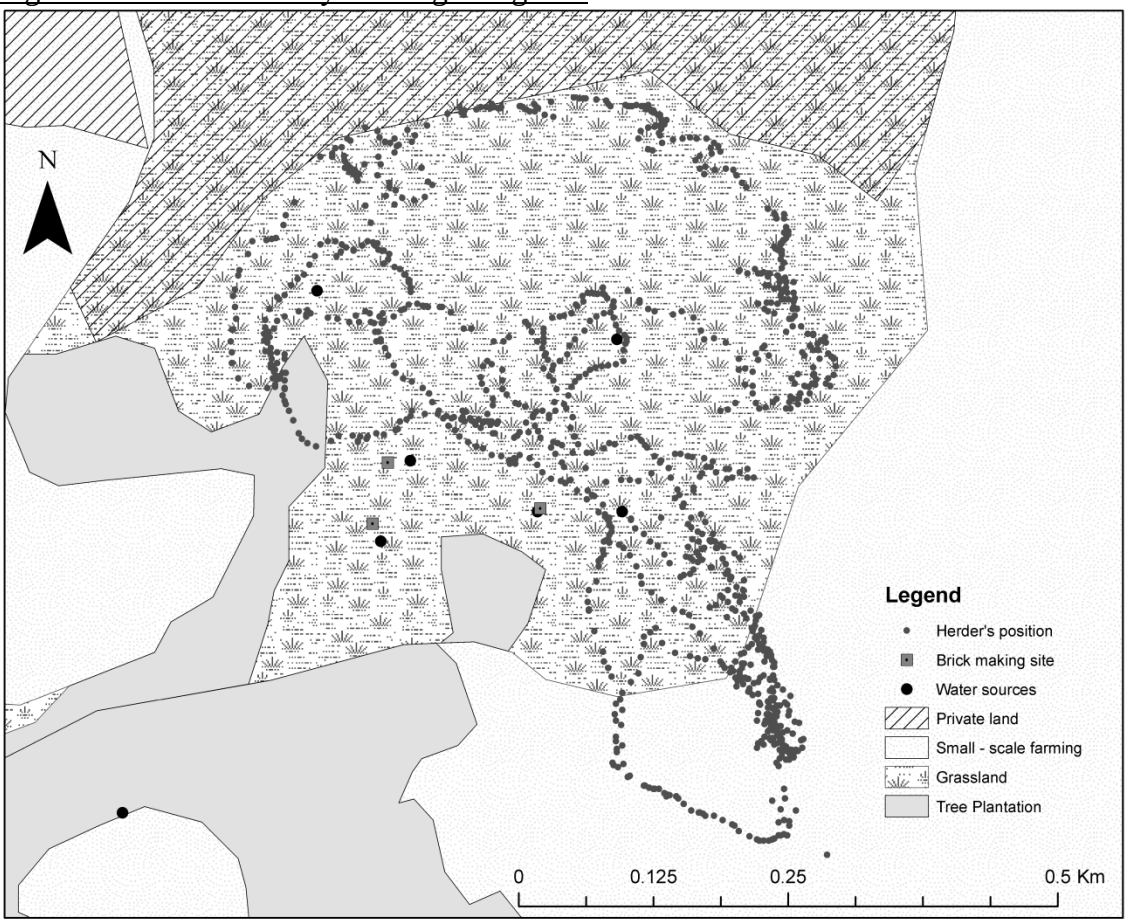
for the available resources, particularly water. These land users are also pursuing a form of enclosure, although in this case the enclosure is temporary and seasonal yet nevertheless significant.

Prominent land users in the wetland areas where agro-pastoralists feed cattle are brickmakers. Demand for bricks has grown in Makondo as a growing number of households look to convert grass houses into more permanent dwellings. To meet that demand, therefore, many entrepreneurs have established relatively small-scale brickmaking enterprises. Making bricks requires clay, water, and space in which to dry the bricks. The dry season is the obvious highpoint of the brickmaking season, hence numerous brickmaking sites are established close to water sources once the rains cease. Brickmakers erected fences around their drying bricks, stacked on top of one another almost like a pyramid, but they also fenced off some reliable water sources for their exclusive use. This move posed a problem for herders because it reduced the availability of water but also took away from them small but much-needed parcels of land on which their cattle would once have grazed. Furthermore, brickmakers were intent on keeping cattle away from the bricks, hence the sought to impose fines on herders if their cattle strayed too close to their plots.

Other land users in the wetland areas were foresters growing Eucalyptus trees to supply the growing market for poles used in the construction of houses. This land use also entailed fencing off portions of the wetland and this added an extra burden to herders. Especially in June and July, I observed the tree growers weeding their plots to protect them from bush fires but I also

saw them building thorn fences to prevent trespassing cattle from damaging the young trees. Figure 6.3 illustrates that herders spent most of their time moving around the grazing herd with the aim of keeping cattle away from trespassing into brick-making sites, eucalyptus trees, other portions of cultivated land, and private pasture land.

Figure 6.3: A herder's day on the grazing trail



A final source of tension was between agro-pastoralists and the wider community that wanted to use water for domestic purposes. My interviews with village leaders and well caretaker committees (as I discussed in Chapter Four regarding Kiganjo Village) revealed that numerous complaints were made against agro-pastoralists. Village leaders blamed the herders for watering

cattle in open wells designated for drinking and cooking water. Especially during the dry season, cattle began to share open wells with people. Consequently, the reaction from many users of the wells was highly negative towards the herders, as the following quote indicates:

> "I hate the dry season because water from Nsozi Biri is shared with cattle. The problem is with these balaalo [herders] who bring their cattle to dip in our well. Their animals make the water dirty; [they] defecate and urinate at open well …what is more annoying is that I have to change my water collection time from 6.30am to as early as 4.30am just to make sure I draw clear and clean water. Yet balaalo are aware that the open well belongs to us…" (Personal Interview, 30 April 2011).

In all the villages I surveyed, the consensus view was that herders were 'irresponsible' people. This perception of agro-pastoralists contributed towards the making of decisions by community and village leaders that undermined the ability of agro-pastoralists to cope with the dry season. For instance, some village leaders had suggested fencing water sources as other villages had already done to keep cattle away from water, such as the Makondo spring which has been improved by the construction of a delivery pipe and a concrete slab that means the water is no longer available to cattle. This form of exclusion severely constrains the adaptive capacity of agro-pastoralists on the grazing field. Thus, about one-fifth of the agro-pastoralists I surveyed said that their entitlements to water and pasture have been violated as a result of decision-making processes that always favour the wider community.

6.5 Summary

On the basis of the evidence discussed in this Chapter, I argue that agro-pastoralists draw upon their local knowledge about water to know where they might try to dig new open well if existing wells run dry. In addition, mobility enables them to cope with seasonal fluctuations, although such mobility is differentiated, with agro-pastoralists owning herds of more than ten animals and who did not have access to banana peels tending to be more mobile than others. Such movements draw upon cooperation and the sharing of resources by calling upon relatives to share information and knowledge and exchange bulls for breeding and re-stocking. Agro-pastoralists also cope with dry spells by culling their herd in sequence during the drier months when pasture and water are problematic. This money is in many cases used to invest in containers for storing water and transporting milk. Finally, agro-pastoralists try to diversify their livelihoods such as by making butter, gee and yoghurt that they sell alongside fresh milk, which increases the integration of these minority tribes in the wider community. I have therefore also argued in this Chapter that agro-pastoralists are important actors in understanding adaptive capacity of the overall community in Makondo. Agro-pastoralists make a significant contribution to the life of the community, including during the dry season. Before a live animal is sold, agro-pastoralists first sell milk to the wider community in order to earn money to buy cheaper forms of calories such as maize grain.

But changes in land use, including permanent and temporary forms of enclosure, make the dry season much harder for agro-pastoralists. Processes of land enclosure confine herders in small areas of pastureland. Such processes mean that herders cannot remain as mobile as they once

were, plus many new landowners have sought to impose fines on herders for trespassing on their land. Furthermore, agro-pastoralists are under pressure to keep their cattle away from non-private land users such as brickmakers and tree growers. All of these non-climatic factors interact to complicate the context within which agro-pastoralists are trying to cope with seasonal fluctuations.

Given these findings, I conclude that agro-pastoralists are finding it much harder to cope with dry seasons, which in turn means their capacity to adapt to climate change is heavily constrained. The sorts of actions they might pursue if there are longer dry spells have limits brought about by the prevailing socio-political arrangements in Makondo. Looking at these micro-scale practices and drawing on a range of ethnographic and participatory methodologies – that is, trying to understand adaptive capacity using a dynamic approach – illustrates just how difficult it is becoming to remain an agro-pastoralist. Given this, it is not surprising to hear agro-pastoralists talk negatively about their future prospects. For example, one herder said:

> "...even if we have balaalo [herders] grouping it can't guarantee our survival. Our weakness is that we are landless and, therefore, powerless. How shall we get pasture in future if we can't afford land today?" (Personal Interview, 15 June 2011).

CHAPTER SEVEN

CONCLUSION

7.1 Introduction

The previous chapter completed the assessment of adaptive capacity in Makondo Parish in southwest Uganda by examining the agro-pastoralists' adaptive capacities and their benefits to wider communities. The chapter ended by discussing constraints that limit the adaptive capacities of agro-pastoralists, specifically by understanding what is happing on the ground in Makondo. Context-sensitive methodologies have been used throughout this dissertation in order to understand adaptive capacity at the level of daily practices. Chapters Five and Six have also discussed the importance of governance and they have demonstrated what people and extra-local actors do: extra-local actors essentially do what they want, which along with processes of enclosure and contradicting policies regarding agriculture and climate change combine to limit the scope of adaptation by the poor in rural areas.

In this final chapter, I would like to briefly conclude my thesis by outlining my achievements and consolidate my findings as well as by noting the shortfalls and limitations, particularly regarding the methodological and conceptual understandings of climate change at the micro-scale.

7.2 Summary statement

Within the climate change literature, past work on adaptive capacity has focused on determinants of adaptive capacity, such as resource endowments, that could determine whether individuals and communities have the capacity to adapt. And, they have modelled adaptive capacity and the process of adaptation in relatively simple, linear terms. In this dissertation, I have argued that adaptive capacity is dynamic because it responds to context, temporal dimension (both dry season and wet season), intra-household and extra-household adaptive capacity, and multi-scale water governance regimes. The interactions of all these factors are likely to offer into contextual insights about adaptive capacity to climate change at the micro-scale. Hence, I have used 'dynamic assessment' in order to capture contextual issues, temporal dimension, intra-household and extra-household and water governance regimes that shape adaptive capacity. Understanding adaptive capacity in this manner has been neglected in previous literature on adaptation to climate change. In this dissertation, I have argued that models or approaches of adaptive capacity ought to include the micro-scale and broader governance regimes. My case study in Kiganjo, Michunda and agro-pastoralists in Makondo support this conclusion:

- The case study of Kiganjo in Chapter Four shows that the application of participatory Geographical Information Systems (PGIS) alongside ethnography at the micro-scale can offer a context-sensitive approach for assessing the complex subject of adaptive capacity. This approach, which I refer to as a 'dynamic assessment of adaptive capacity' can helps to uncover the complex realities with regards to social connections and connections with place. The approach makes 'small' contextual contributions to adaptive capacity by individuals more visible that are generally overlooked in traditional approaches of

participatory GIS intended for building databases. My dynamic assessment can also reveal critical data about people and their places that might not otherwise emerge; data that may be of importance to understanding adaptive capacities.

- The adaptive capacity and governance case (Chapter Five) shows that relations and practice regarding water governance may also affect the adaptive capacity of the rural population to cope with extreme climate change impacts. In this case study, I have argued that coping mechanism respond to temporal dimensions. Households draw upon different coping mechanisms during dry and wet seasons such as water recycling and RWH but these are greatly influences by intra-household and extra-household relations. My dissertation argues that context-based adaptive strategies people display are inadequate if other issues are not addressed, such as gender-based and village-level water governance mechanisms; both of these limit how future adaptive strategies will develop.

- Using the case of agro-pastoralism, I have also discussed how adaptive capacity is happening via a complex web of relationships that can hinder successful adaptation at the individual level. Agro-pastoralists display some adaptive capacity that draws on local knowledge, mobility, culling their herd and diversify their livelihood to cope with drier months. Context-based adaptive capacity of agro-pastoralists has become increasingly unsustainable mainly because of the growing land pressure that has caused changes in land use. On the ground changes include permanent and temporary forms of enclosure, which make the dry season much harder for agro-pastoralists. Adaptive capacity

inequalities are widening between agro-pastoralists, especially regarding access to water and pastureland. Consequently, agro-pastoralists speak negatively about their future prospects.

My findings in this dissertation are important because they suggest that a dynamic assessment, such as PGIS and ethnography, can offer a methodology that can help dynamically assess adaptive capacity at the micro-scale. Indeed, the results in this dissertation describe the current adaptive capacities of the individuals and communities in Makondo and the process of adaptive capacity enhancement at the micro-scale in rural Africa. This dissertation has significant implications on how external interventions can address vulnerability. In this dissertation, several governance factors have demonstrated ability to influence peoples' intentions, and actions in response to vulnerability. I have argued that individuals and households may lack managerial capabilities. Indeed, shallow wells, boreholes, and RWH tanks were available to communities, but they lacked proper governance. The findings in this dissertation show that the coping mechanisms are dynamic and rapidly changing in response to multiple pressures beyond climate change. I argue that it is difficult to sustain adaptive capacity within and without households at the micro-scale because of its dynamic nature.

The overall picture of adaptive capacity in the study communities shows that the practices of local communities on the ground help them to ameliorate their livelihoods during the different seasons. The current coping mechanisms include digging more open wells, water recycling, local knowledge, mobility and diversifying livelihoods. These coping mechanisms have the potential

to enable the households and communities in the study area to cope with future climate change if external interventions draw upon them as 'platforms' provided by local adaptive capacity. My findings demonstrate that the most beneficial case is when proactive strategies, such as investment in shallow wells and RWH, can consider what local people already know and do in rural Africa. It is important to sensitively consider these platforms at the micro-scale because coping mechanisms change rapidly within a season and between seasons. I have argued that a household can be described as having adaptive capacity today, but that the same household can become vulnerable three days later or a week after. This is usually because coping mechanisms at household levels tend to be reactive to multiple pressures beyond climate change (e.g. Ziervogel et al., 2006). In Chapter Four, I have discussed that having an asset creates the possibility to cope with the dry season, but effective use is made difficult due to differential adaptive capacities that exist between households and gender groups. In summary, the coping mechanisms that exist at the micro-scale are inadequate by themselves and, consequently are not independent of external influence. These coping mechanisms are connected to extra-local actors and the broader socio-political economy.

With regards to extra-local actors' influence, I have endeavoured to underscore the centrality of governance, specifically the need of connection in enhancing adaptive capacity. I have demonstrated that extra-local actors are crucial players because they deliver critical determinants of adaptive capacity. These determinants are: water infrastructure, financial resources, and formal governance mechanisms. Extra-local actors have delivered boreholes, shallow wells, and facilitated creation of Water User Committees. Further, extra-local actors have offered financial

support to repair some water sources in the study areas but this support depends on communities actively participating by "doing something". If the communities don not actively participate these relations may not endure.

In this dissertation, there are some constraints that will likely limit future adaptation to climate change in rural Africa, such as: changes in water governance regimes, processes of land enclosure, and when a community perceives their coping mechanisms as inferior to enable them to cope with future vulnerability.

Although governance is an integral determinant of adaptive capacity at the micro-scale (e.g. Vincent, 2007), water governance is characterized by numerous constraints in Makondo that limit present and future adaptive capacity. I have argued that good intentions about setting up Water User Committees, to oversee operations and maintenance of water facilities, are aggrieved by bad attentions. In Chapter Five, I have discussed how the promotion of cash payments for the maintenance of water sources as opposed to in-kind payments is constraining the new governance regime. I have argued that the new governance regime has brought new challenges that affect micro-scale collaboration, innovation and decision-making because the new governance places too much value on effectiveness. I have argued that new institutions like WUC have become a political arena and politicians contribute to the demise of the WUC. Politicians use WUC to advance their agendas by assuming responsibilities of operations and maintenance thereby making WUC redundant. Hence if extra-local actors continue *doing what*

they want, the risk is that their actions will heighten vulnerability in places such as Makondo Parish.

Changing relations will limit adaptive capacity at individual levels because of growing pressure on water resources. In Chapter Five, I have argued that there is clear lack of commitment on the part of extra-local actors to adhere to tenets of participatory governance at the action level because of budgetary issues. My conclusion is a long outstanding issue in development geography; in particular, the bottom-up knowledge integration may not get full support from extra-local actors (Brigg, 2005; van Aalst et al., 2008). The withdrawal of external support and the tendency of extra-local actors not abiding by standard procedures stated in the District Implementation Manual by the Ministry of Water and Environment (GoU, 2007) can threaten adaptive capacity in Makondo Parish.

In Chapter Six, I have discussed how processes of enclosure are shaping relations at an individual level. This dissertation demonstrates that as climate change continues and socio-economic and political pressures increases, it is unlikely that current coping mechanisms drawing on social capital will be adequate to allow the community members in Makondo Parish and more generally in rural Africa to adapt with what future climate change models predict. I have discussed, for example, how agro-pastoralism is becoming individualistic. Processes of land enclosure may negatively influence coping mechanisms such as the use of local knowledge about the wetland, micro-scale mobility, cooperation and sharing, and diversification. Such processes mean that agro-pastoralism cannot remain as it once was. Further, in Chapters Five and Six, I

have discussed growing conflicts for available resources, particularly water. There is conflict between agro-pastoralists and landowners and agro-pastoralists and the wider community as well as among the wider community at water sources. These competing interests regarding water use are in agreement with the general literature on adaptive capacity discussed in Chapter Two (e.g. Dobzhansky, 1956).

My findings demonstrate that the perception communities may hold about their coping mechanisms may limit their adaptive capacity. In this dissertation, the wider community and agro-pastoralists perceived their coping mechanisms as inferior to enable them to cope effectively. The researched community did not have confidence about local actions such as water recycling and talking to one another because these coping mechanisms are viable when water is least accessible. Nevertheless, further research could answer several important questions; one of them is to what extent is talking about water management applicable beyond the temporal dimension I have presented, to predict adaptive capacity across a wide range of cultures and conditions? In Chapter Six, agro-pastoralists explicitly talked negatively about their future adaptive capacity because they are landless. I argue, therefore, that there could very well be a systematic bias towards underestimating the proactive adaptive capacity with regard to climate change impacts. People showed lack of confidence in their coping mechanism when talking to each other and digging of more open wells during the dry seasons. I am not proposing that determinants of adaptive capacity like the infrastructure (boreholes, shallow wells and RWH tanks) stated by the IPCC authors or institutional structures and entitlements are unimportant determinants of adaptive capacity. But if individuals and communities systematically

underestimate their own ability to cope, I argue that this qualifies as a more important constraint for future adaptation than the physical resource endowment. Literature reviewed in Chapter Two has revealed that adaptive capacity is influenced by the perceived adaptive capacity. This is because individuals' perceptions of their adaptive capacities are often partly realistic.

I argue that if individuals' coping mechanisms are perceived as inferior to proactive adaptive strategies, then there may exist important extra-local intention or policy interventions that have not yet effectively benefited the community in Makondo. Moreover, I argue that in taking actions to promote a particular adaptive strategy, it would be worthwhile for extra-local actors to focus on cognitive constraints that may exist because the disregard of local perspective can negatively influence adaptive capacity at the micro-scale.

7.2 Dissertation Shortfalls

Although I have argued that the current literature shows no consensus on how to assess adaptive capacity, in particular at the micro-scale, which means that there is no specific approach to characterize adaptive capacity, I recognize some shortfalls with my dissertation as with any other scholarly work.

- *Methodological issues*: While PGIS is a useful tool in assessing adaptive capacity at a local level, I observed that GIS analysis can mask small but critical issues such as the emotions of congestion and the burden that women face regarding water governance. Aggregation of narrative materials from individuals, households, to village level led in my research to a loss of details on local knowledge at community level. This was

observed during the community workshop in which PGIS outputs such as were presented. Women and men interpreted the same maps differently because each groups observed omissions of some attributes considered as crucial to them. For example, women narrated about congestion at water source while men emphasized the politics of water regarding extra-local actors and their influence on the operation and maintenance of boreholes. I am compelled to argue that PGIS ought not to stop at mapping or GIS database generation but should also boost and sustain the role people can play across all levels of decision-making. Rather than seeing the PGIS process as having a conclusion, I argue that there can be no end if findings are to be authentic: the processes need to remain recursive and continually iterative, which raises obvious difficulties when a research project has limited resources and deadlines that need to be met. The findings presented here, therefore, are a 'partial truth' about adaptive capacity in Makondo.

- *The multidisciplinary nature of PGIS*: GPS-assisted mental mapping aimed to integrate local knowledge with scientific knowledge. A starting point for knowledge integration is acknowledging the value of local knowledge in adaptive capacity to climate change and seeking ways of developing rapport with local people. This alone is a daunting task because it requires the shifting of existing knowledge and power relations between 'scientific' and 'indigenous' people regarding the well-being of rural population (see, (2005)Briggs, 2004). Although I touched on this issue in the dissertation, I find my study inadequate. I have been silent on how development and adaptation strategies that augment mutual sharing of information and different forms of knowledge can foster

effective and inclusive communication between these two spheres. This is particularly important at the local scale where the digital divide is still a major barrier (discussed in Chapters Three, Four and Six) and where dynamics of politics and power are manifested and entrenched in structures mediating adaptive capacity. Knowledge integration remains central to PGIS in a rural setting, but there remain questions about how local adaptive capacity can best be acknowledged and then used by local experts and politicians, not only during the workshop but also in a process that adequately integrates local knowledge into broader structures beyond the micro-scale.

- *Climate change adaptation complexity*: Climate change adaptation as a subject pushes the limits of what can be unpacked and investigated in a participatory manner. During my fieldwork, for example, I realised that contingencies that affected livelihoods were used to explain what climate change was, for example, wilting of crops, death of cattle, loss of income, and drying of water sources etc. Climate change at the micro-level meant something different to conventional understandings (e.g. IPCC, 2007). At the micro-scale, climate change was perceived as a hazardous event that impacted on people's well-being, feelings, and indeed memories of vulnerability all of which viewed as outcomes of climate change throughout my field work.
- *Tensions about PGIS*: In spite of the many possibilities presented by both PGIS and ethnographic approaches, during the field work, I experienced methodological tensions. My dynamic assessment did not offer remedies for all the ethical, political and practical issues on the ground. As a result, PGIS processes and the resulting maps and database were insufficient on their own. Notable tensions were the following: Firstly, I was unable

to keep pace with the insights coming from each observation and updating this GIS database files about a particular relationship people had with places, especially between people and various water sources, it was very difficult. It was very challenging to synchronize when and how to analyse data collected via GPS and ethnographic approaches. Ethnographic data analysis is an on-going activity (e.g. Fatterman, 2010); thus, each successive new insight gained during a field interview or observation required a new understanding and new analysis. Each visit I made to water sources had different experiences and lessons (e.g. the field notes and photographs told a different story about adaptive capacity) while the spatial location (in GPS and GIS) remained same. It was hard to fully describe the dynamics of the researched individuals' relationships with places by using a map alone; each time, I found the map out of date. The second tension arose from the first are regarding the large dataset generated when PGIS and ethnographic methodologies are combined – data handling can become a nightmare. I had both volume and variety of ethnographic data such as text, audio and pictures to enrich the PGIS. However, these datasets raised tensions regarding handling and execution problems. As someone from geo-spatial background, I was tempted to simply work with the data in order to, for example verify geospatial data accuracy and to link ethnographic data to a GIS database. I referred to the existing government GIS database, which was unhelpful as I faced a number of challenges regarding the quality of the government geospatial data when compared to the ethnographic data (this has been discussed in Chapter Four). Primarily, the two main problems I encountered with official data were missing data and incorrect data. To improve on the data available from this

source was time consuming. As a result, my GIS database remained static and out of date because of my limited capacity to catch up with the dynamics of adaptive capacity from ethnographies. Although Kesby et al. (2005) argue that tools such as PGIS are ideal for researchers faced with time constraints, because they allow getting direct access to the research objectives' data, the use of technology to generate data may be intrusive and my end up compromise on the level of participation, where the research becomes action driven activity (Chambers, 2006). Thirdly, there were tensions between the ethos of PGIS and ethnography. Privacy concerns and confidentiality are central issues in debates in GIS & Society (e.g. Pickles 1995), PGIS practice (e.g. Chambers, 2006 and Elwood, 2006) and ethnographic enquiries (e.g. Fetterman, 2010). Ethnographers place great emphasis on privacy and the risks of identifying research participants and their place. For this reason, I was limited as to how much information could be mapped; hence, several controls and mapping strategies, both during GPS-assisted mental mapping and desktop GIS, were employed to avoid privacy violations. For example, data that respondents felt uncomfortable with were deleted for privacy reason even when I felt that such data would be crucial to map and include in database. In this dissertation ethnographic geographies included information on the location of key points such as houses, water sources by types, routes (roads and footpaths), general land uses and rainwater harvesting technologies. These datasets are presented in Chapters Four, Five and Six with specific accompanying limitations. As implied by these limitations, the maps of the study area were lacking detailed referencing data to avoid identification of research community

members or the origin of respondents such as agro-pastoralists (discussed in Chapter Six).

Given the above tensions, my dynamic assessment was somewhat different from most PGIS processes in Africa e.g. Minang and McCall (2007), McCall (2005) and Mbile et al. (2003) which only aimed at democratizing GIS and the governance of livelihoods' resources as detailed by Chambers (2006). In this dissertation, I added the dimension of ethnographic rigor to help me to learn the ways in which people cope with multiple pressures. The GPS-assisted mental mapping was complemented by ethnographic techniques in order to explore the question of space and social meaning to people with the intension of being un-exploitive and seeking to challenge the power imbalance between researchers and researched.

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