



LUND UNIVERSITY

Uncertain Futures

Adaptive capacities to climate variability and change in the Lake Victoria Basin

Gabrielsson, Sara

2012

[Link to publication](#)

Citation for published version (APA):

Gabrielsson, S. (2012). *Uncertain Futures: Adaptive capacities to climate variability and change in the Lake Victoria Basin*. [Doctoral Thesis (compilation), LUCSUS (Lund University Centre for Sustainability Studies)]. Lund University Centre for Sustainability Science.

Total number of authors:

1

General rights

Unless other specific re-use rights are stated the following general rights apply:

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

Read more about Creative commons licenses: <https://creativecommons.org/licenses/>

Take down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

LUND UNIVERSITY

PO Box 117
221 00 Lund
+46 46-222 00 00

Uncertain futures

ADAPTIVE CAPACITIES TO CLIMATE VARIABILITY
AND CHANGE IN THE LAKE VICTORIA BASIN

SARA GABRIELSSON



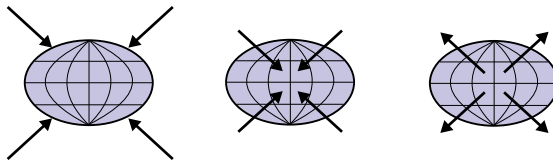
LUCSUS

Lund University Centre for
Sustainability Studies

Lund Dissertation in Sustainability Science No. 3



LUCID -
Lund University Centre for Excellence for
Integration of Social and Natural Dimensions of Sustainability



LUCID is a Linnaeus Centre at Lund University. It is funded by the Swedish Research Council Formas, comprises six disciplines from three faculties and is coordinated by LUCSUS as a faculty independent research centre. Research aims at the integration of social and natural dimensions of sustainability in the context of grand sustainability challenges such as climate change, biodiversity loss, water scarcity and land use change. The scope is broad, the ambition is bold and the modes of operation are collaborative. Over the course of ten years we will develop sustainability as a research field from multidisciplinary to interdisciplinarity to transdisciplinarity.

***Sustainability is not about something to be solved
but about something to be lived***

Author's e-mail address:

sara.gabrielsson@lucus.lu.se

© 2012 Sara Gabrielsson

ISBN: 978-91-7473-310-5

Cover design and photo: Sara Gabrielsson

Graphics: Ann Åkerman

Printed in Sweden by Tryckeriet i E-huset, Lund 2012

I dedicate this work to

Nancy,
and all other women
across the global south, who,
like her, relentlessly strive to provide and care
for their families despite all the challenges facing them.



Photo 1-2. Nancy with Agnes in her lap in 2008 (Left). Me and Agnes in 2011 together with Nancy's kids; Stella, Stanley and Johannes (Right). Gabriellsson, a.k.a. "Gabby" is missing in the photograph. (Photo by Andreas Gabriellsson, 2008-11)

Agnes,
and every other child in the world,
who, like her, deserve to inherit a planet where
sustainability and equality is common sense and practice,
not merely fancy academic rhetoric and discourse.

Abstract

The Lake Victoria basin (LVB) in East Africa can be considered a climate change hotspot because of its large rural population dependent on rain-fed farming. Drawing on extensive fieldwork (2007-2011) in rural communities along the shores of Lake Victoria in Kenya and Tanzania, I explore adaptive capacities to climate variability and change and discuss how they interrelate in situ. Using multiple methods, tools and techniques, including survey and rainfall data, individual and group interviews, interactive mapping of seasonal calendars and a multi-stakeholder workshop, I locate the place-based effects and responses to a number of converging climate induced stressors on smallholder farmers' wellbeing and natural resources. Research findings show that adaptive capacities to climate variability and change in the LVB are complex, dynamic and characterized by high location-specificity, thereby signifying the value of using an integrative and place-based approach to understand climate vulnerability. Specifically, the study demonstrates how increased unpredictability in rainfall causes chronic livelihood stress illustrated by recurring and worsening periods of food insecurity, growing cash dependency and heavy disease burdens. The study also reveals that food and income buffers increase when and where farmers, particularly women farmers, collectively respond to climate induced stressors through deliberate strategies rooted in a culture of saving and planning. Nevertheless, the study concludes that smallholders in the LVB are facing a highly uncertain future with discernible, yet differentiated adaptation deficits, due to chronic livelihood stress driven by unequal access to fundamental adaptive capacities such as land, health, cash and collective networks.

Keywords: adaptive capacities, climate vulnerability, collective action, Lake Victoria Basin, smallholder farmers, sustainable adaptation, sustainability science.

CONTENTS

Acknowledgements

List of abbreviations and acronyms

List of articles

Chapter 1. Introduction **p. 11**

Study aim and research questions

Topic and study location rationale

Research scope and limitations

Structure of the thesis

Chapter 2. Conceptual framework **p. 18**

Climate vulnerability

Adaptation

Adaptive capacities

Sustainable adaptation

Chapter 3. Research approach and process **p. 27**

Doing sustainability science

Research design and strategy

Fieldwork methods

Data analysis and integration

Ensuring research quality

Chapter 4. Study context and setting **p. 42**

History matters – old and new realities for smallholders

The landscape of the Lake Victoria basin

People and livelihoods in the Lake Victoria basin

Chapter 5. Synthesis and contributions to current debates **p. 54**

Chapter 6. A concluding remark on Sustainability Science **p. 60**

References

Articles 1-3

Appendices

Appendix 1 – Exploratory Household Questionnaire

Appendix 2 – Stakeholder workshop set-up and agenda

Appendix 3 – Workshop Declaration

FIGURES and TABLES

Figure 1. Primary and secondary study sites in the LVB

Figure 2. Conceptual and spatial focus of the three articles

Figure 3. Compound elements of climate vulnerability

Figure 4. Conceptual overview of vulnerability-poverty linkages

Figure 5. Annual rainfall variability 1951/59-2007/08

Figure 6. Constraints to sustainable adaptation in the LVB

Table 1. Data collection strategy 2007-2011

PHOTOS

Photo 1-2. Nancy and Agnes in 2008 and 2011

Photo 3-4. Focus groups with female farmers in Kakola and Onjiko, Kenya

Photo 5-6. Focus group introductions in Kisumwa, Tanzania

Photo 7-8. Discussing seasonal calendars in Kunsugu, Tanzania

Photo 9. Primary freshwater source in Thurdibuoro, Kenya

Photo 10. Article 1 preface - View of a homestead in Mara, Tanzania

Photo 11. Article 2 preface - Happy child in Kunsugu, Tanzania

Photo 12. Article 3 preface - On the road in Mara, Tanzania

Acknowledgements

This research endeavour would not have been possible without the support, encouragement and assistance from a number of people along the way.

I am first and foremost indebted to Andreas, who have not only supported me emotionally throughout this almost 6 year journey but also physically by being there to shoulder my part of our shared parental responsibility, when I could not. You have always encouraged me to carry on, even when I found no reason to. Your enthusiasm and interest in my work has challenged me to become a better researcher. I know that despite the many emotional hardships this journey has caused us, in the end it has also contributed to making our relationship stronger by building on our mutual respect for one another. You and Agnes are and will forever be the ultimate reason for why I keep on going.

In East Africa I would like to thank all those people who assisted me in the field, especially, Benson Gudu, Nancy Otiende and Deus Cosmos as well as Aluther Kamugunda, Nancy Genga, Audax Kahyoza and Victor Okoth Ochieng.

At VI-Agroforestry in Kisumu and Musoma several people have supported this project in one way or another. Those who deserve particular mentioning are: Bo Lager, Wangu Mutua, Pamela Abila, Ylva Nyberg, Amos Wekesa, Björn Horvath, Neema Kitila, Gabriel Songa, Michael Wamalwa. Special thanks also to Henric, Jenny, Siri, Ellen and Karl Brundin who let me stay at their house in Musoma to keep me safe from malaria carrying mosquitoes while I was pregnant.

In Lund I want to thank my supervisors; Anne Jerneck and Lennart Olsson. Anne, I am so grateful for all your relentless support, both academically and personally. Lennart, thanks for seeing my research potential and always believing in my ability to finish. I also want to extend my gratitude toward my co-authors; Elina Andersson, Sara Brogaard, Anne Jerneck and Vasna Ramasar, whose collaboration not only have made me a better writer but also convinced me that I actually have something to say.

I am also thankful for my office mates at LUCSUS; Torsten Krause, Bodil Elmqvist, Anna Kaijser, Yengoh Tambang and Cheryl Sjöström for keeping my spirits up even when things got rough.

Thanks also to those who have commented or reviewed my work, especially Barry Ness, Christine Wamsler, Mine Islar, Sandra Valencia, Molly McGregor, Stefan Anderberg, Kimberly Nicholas and numerous anonymous reviewers.

I have also received vital collegial support both on and off work from Johanna Bergman-Lodin, Andrea Nardi, Mabel Hungwe, Stefan Anderberg, Ann Åkerman, Ingegerd Ehn, Cecilia Kardum-Smith, Amanda Elgh, Maryam Nastar and Melissa Hansen.

Thanks also for generous financial support from; The European Union through 'Adaptation and Mitigation Strategies- Supporting European Climate Policy (ADAM)', Sida through funds for the research project on 'Livelihoods and Climate Change Vulnerability in the Lake Victoria Basin -Visioning Future Adaptive Strategies through Participatory Methods', The Swedish Research Council Formas, The Crafoord Foundation, The Gösta and Märta Moberg Research Fund, The Swedish Society for Anthropology and Geography, Lund University and Lund City Jubilee Foundation.

To my oldest friend Karin Fransson I want to say, thank you for always being there and lending me your ear. I know you always believed that I could do this, I am so happy to say that you were right.

Finally, my deepest gratitude and respect goes out to the many farmers that willingly have participated in this study in Kenya and Tanzania, especially the farmer groups in Kunsugu, Kisumwa, Thurdibuoro and Onjiko. Thank you all for inviting me into your homes and allowing me to take part of your lives. I admire all your collective efforts to shape a better future for yourself.

Ero Kamano ~ Asante Sana.

Malmö, April 2012
Sara Gabrielsson

Abbreviations and acronyms

ACTS	African Centre for Technology Studies
CEEST	Centre for Energy, Environment, Science and Technology
COP	Conference of the Parties
EAC	East Africa Community
EHS	Exploratory Household Survey
ENSO	El-Nino Southern Oscillation
FGD	Focus Group Discussions
HES	Human-Environment System(s)
ILRI	International Livestock Research Institute
ICRAF	World Agroforestry Centre
IPCC	International Panel on Climate Change
KMA	Kenya Meteorological Agency
LVB	Lake Victoria Basin
NGO	Non-governmental Organization
SAP	Structural Adjustment Program
Sida	Swedish International Development and Cooperation Agency
SS	Sustainability Science
SSA	Sub-Saharan Africa
TMS	Tanzania Meteorological Services
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
URT	United Republic of Tanzania
Vi-AFP	VI Agroforestry Programme

Articles and work contributions

This PhD thesis consists of the following three articles:

- I. Gabrielsson, S., Brogaard, S and A. Jerneck (2012) 'Living without buffers – Illustrating climate vulnerability in the Lake Victoria Basin' manuscript submitted to *Sustainability Science*. Under review.
- II. Andersson, E. and S. Gabrielsson (2012) 'Because of poverty we had to come together- Collective action as a pathway to improved food security in rural Kenya and Uganda' *International Journal of Agricultural Sustainability*, DOI: 10.1080/14735903.2012.666029
- III. Gabrielsson, S., V. Ramasar (2012) 'Widows: agents of change in a climate of water uncertainty' *Journal of Cleaner Production*, DOI: 10.1016/j.jclepro.2012.01.034

The work contributions of the authors are described below.

- I. Gabrielsson structured and wrote the paper with contributions from Brogaard and Jerneck. The article draws on data collected by Gabrielsson and Brogaard in 2009 and 2010, as well as data collected by Gabrielsson in 2007, 2008 and 2011.
- II. Andersson and Gabrielsson contributed equally to the article by combining separately collected data from their respective study sites in Uganda and Kenya, compiling and analyzing it in conjunction and then writing the paper together.
- III. Gabrielsson structured the paper and then wrote it with inputs from Ramasar. Gabrielsson collected, compiled and analyzed all the data from 2007-2011.

1. Introduction

Sub-Saharan African (SSA) is viewed to be particularly vulnerable to climate change, especially changes in rainfall (Vogel, 2000; IPCC, 2007). Several factors contribute to this vulnerability, among other things, a large rural population highly dependent on rain-fed agriculture coupled with structural problems of chronic poverty, food and livelihood insecurity and socio-economic and political inequality (Vogel, 2000; Ikeme, 2003, IPCC, 2007; Tschakert and Dietrich, 2010). Coping with and adapting to climate variations is not a new phenomenon for farmers in SSA, indeed it has been an ongoing process for centuries (Tyson et al., 2002). The difference today however, is that global climate change is likely to exacerbate already hard livelihood conditions, due in part to the sheer magnitude and complexity of the anticipated changes and the probability and severity of increased extreme weather events (Ikeme, 2003).

For the majority of smallholder farmers inhabiting the Lake Victoria basin (LVB), life is invariably a struggle. Reliance on rain-fed agriculture to sustain major food and income needs, poor infrastructure and weak market access in addition to unequal social relations, hamper abilities to live a full and healthy life and buffer themselves against and rebound from the impacts of climate related stressors (Ribot, 2009). This complex and uncertain reality poses obvious challenges to the lives and futures of smallholders, but also to researchers, policymakers and other stakeholders concerned with ways to reduce these struggles now and in the future.

The LVB, shared by Kenya, Tanzania, Uganda, Rwanda and Burundi is not only home to Sub-Saharan Africa's most densely populated and poorest rural farming communities it also has tremendous significance as a climate modulator for the entire East African region (UNEP, 2006). As such, the LVB is a suitable location for an integrative study on adaptive capacities to climate variability and change informed by sustainability science, due to its emphasis on understanding coupled human-environmental systems (HES) (Clark, 2007).

While there still remains a lot of uncertainty in the regional climate change predictions for the LVB (UNEP, 2006; Kizza et al., 2009) some of the expected repercussions of climate change for East Africa include increased rainfall, flooding, runoff and incidence of disease in wetter areas, worsening

droughts, erosion and crop failures in drier areas (MLWE, 2002, URT, 2003; IPCC, 2007; Olago et al., 2007; Dinar et al., 2008; Odada et al., 2009; Thornton et al., 2010). And even though rural dwellers the LVB may have the ability to cope with long-term changes in temperature and precipitation patterns in the future, the increased incidence of erratic rainfall in the basin in recent years (Kizza et al., 2009) are exposing people to new conditions that may be difficult to avoid and prepare for. Consequently, understanding how people here are vulnerable is important, not only to future climatic changes but also to present climate variability, because of its potential to improve livelihood security and contribute to sustainable adaptation.

Using a place-based approach, through documenting the processes of change, in primarily four rural communities in the LVB of Kenya and Tanzania, this thesis explores how smallholder farmers experience and manage changing livelihood conditions induced by climate variability and change. To that end the thesis seeks to examine both exogenous threats to farmer livelihoods and wellbeing as well as the endogenous adaptive capacity that farmers have to manage such threats (Preston et al., 2011) in an attempt to downscale global climate change into a local context where it is experienced.

Study aim and research questions

The aim of this thesis is to critically examine the exogenous threats of climate variability and change on smallholder farming livelihoods and the endogenous adaptive capacity that farmers have to manage such threats, with a particular focus on ways to improve sustainable adaptation in the future.

Three research questions guide this inquiry:

- 1) How are smallholder livelihoods affected by climate variability and change?
- 2) What capacities do smallholders employ to cope with and/or adapt to climate variability and change?
- 3) How are smallholders' adaptive capacities facilitated or impeded by present socio-structural and economic processes?

Topic and study location rationale

Doing sustainability science (SS) is quite different from doing other types of research, primarily because of its normative goal of achieving sustainability through global inter-generational and intra-generational justice (Clark, 2009; Ziegler and Ott, 2011). SS thus has dual objectives, to meet the needs of society *while* sustaining the life support system of the planet (Turner et al., 2003). Besides being a normative science it also features a temporal element by asserting that there is an urgency to resolve the global challenges facing the planet because ‘the search for solutions cannot wait’ as expressed by Komiyama and Takeuchi (2006). In addition, SS strives to employ multi-scalar approaches that explore the local through a global lens and vice versa.

A major distinction between the field of SS and other academic disciplines is that it is driven, and thereby also, defined by the problems it addresses rather than by the disciplines that it employs (Clark, 2007). The problem driven nature of the field also plays a role in how sustainability science research is evaluated or measured. Although scientific merit and critical contributions are important, its capacity to deliver results, recommendations and problem resolutions for achieving sustainability is said to have even more significance (Kates et al., 2001; Clark and Dickson, 2003). Thus, SS takes an integrative approach to knowledge production, whereby research transcends the concerns of its foundational disciplines in an effort to understand the complex dynamics that arise from interactions between human and environmental systems (Clark, 2007). Central queries within SS thus relate to understanding the fundamental properties of complex, adaptive human-environment systems, such as smallholder livelihoods in the Lake Victoria basin and how they relate to major transformative processes.

My choice of research topic and focus on Africa and the Lake Victoria basin more specifically, is deliberate as it is the region where the “adaptation deficit” (Osbaahr 2007), i.e. the lack of explicit integration of livelihood adaptation to climate change and broader development issues, has been most evident (Tschakert and Dietrich, 2010). Consequently it is in the global south that meeting human needs in times of global environmental change poses greater challenges and urgency. Hence as a PhD candidate in Sustainability Science it is also here that my research findings may be most valuable and useful.

Research scope and limitations

This thesis is based on empirical data collected in primarily four rural farming communities in the LVB (See figure 1).



Figure 1. Primary and secondary study sites in the LVB (Source: ILEC, 2005)

Beside these four study sites empirical data from seven other study sites in the Mara and Nyando region have also been collected in the form of a household survey as well as episodic interviews and focus groups. The spatial scope of the study can thus be divided into two groups. One with the primary study sites: *Thuridibuoro* and *Onjiko* location in Kenya; and *Kisumwa* and *Kunsugu* ward in Tanzania (combined black and white dots in fig 1). These sites have been visited throughout the duration of the research project from 2007 to 2011, while the other, secondary study sites: N.E. Nyakach, Kolwa, Kakola in Kenya, and Ravour, Makojo, Bukimwa, Kabasa in Tanzania (black dots only in fig. 1) were only included during the first two years of research to enable me to compare and contrast between different farming communities

to identify key features and characteristics of rural smallholder livelihoods in the LVB.

Although this research project is based on empirical data from two countries it is not a comparative study, instead this research should be seen as an exploration of the concept of adaptive capacities to climate variability and change, whereby Kenya and Tanzania represent two units of analysis within specific sites. As such I expect to find similarities between the two units while exploring the differences to further my argument about what constitutes adaptation and adaptive capacities to climate variability and change in a smallholder context in rural Sub-Saharan Africa.

This thesis is based on three stand alone articles, which can be read as a combined exploration of how smallholder farmers in the LVB live with and manage climate variability and change. The three articles all focus on farmers' personal experiences of climate variability and change but the difference between them lies in the spatial focus and the conceptual framing of each.

Article 1 is both a comprehensive exploration of the concept of climate vulnerability and a synthesized analysis of all of the collected empirical data. As such the article includes data both on households and communities as well as a policy review for the region as a whole.

Article 2 proceeds from the concept of communities of practice (Wenger, 1998) to identify in detail, both theoretically and empirically how collective action among organized farmers increases adaptive capacities to respond to various multiple stressors, including climate unpredictability. The article is the outcome of collaboration with a fellow PhD candidate at LUCSUS who do related studies on smallholders in Uganda.

Article 3 focuses solely on widows as agents of change in Onjiko, Kenya. Drawing on feminist political ecology and Kabeer's (1999) conceptualization of empowerment progression the article analyzes in-depth how widows, through increased agency, have improved their individual and collective capacity to respond to increased water uncertainty.

Finally, the 'coat', and particularly chapter 5, attempts to integrate the findings from each article and discuss them in relation to the implications for sustainable adaptation (Eriksen and O'Brien, 2007).

Figure 2 below gives an overview of the scope of the three articles in terms of concepts used and spatial levels studied.

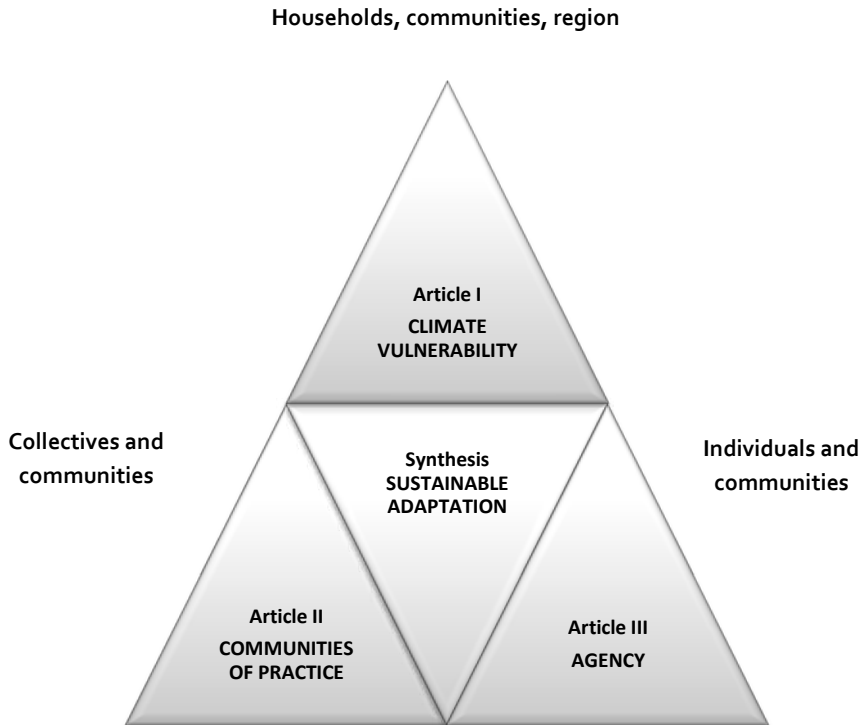


Figure 2. The scope of the three articles with reference to: spatial level and conceptual frameworks.

The limitations of this research are first and foremost linked to the complexity and variability inherent in the human-environment system that I study, where not only the actual variability in the biophysical system is unpredictable but also the parameters of the social system are in flux. Additional limitations to this can be linked to the missing and sometimes lacking data on different local climate parameters, poverty-, health- and demography indicators which hamper abilities to explore more detailed interactions of the location specific human-environment system.

Moreover, as a major requirement of a thesis in Sustainability Science this research attempts to bridge the natural and social science divide by considering both the environmental and human dimensions of smallholder farming livelihood systems. But owing to the fact that a PhD thesis is mainly an individual task and that I have my base in the social sciences as a result of my previous academic training in anthropology and environmental studies, my abilities to integrate the natural and social dimensions of sustainability are somewhat restricted.

Structure of the thesis

This coat should be read as an introduction to the concepts used in the articles (chapter 2) as well as a more detailed account of the research approach and process including the various methods (chapter 3) employed to explore these concepts. Following this, chapter 4 gives a more detailed introduction to the specifics of the study setting and the historical and cultural context of smallholder farming. Chapter 5 includes a synthesized discussion of the study's empirical findings and a commentary on the implications of these findings for sustainable adaptation in the LVB and Sub-Saharan Africa at large. Finally, chapter 6 identifies some of the key lessons learned from this research endeavour for sustainability science.

2. Conceptual framework

The theoretical and analytical framework(s) that the researcher uses as a departure point and as a navigating tool throughout the research process also guides the reader in his/her understanding of the core issues under study. This section presents the core concepts and terminology underlying the discussion and analysis of this thesis. The terms presented here do not follow an all-inclusive framework but rather a set of different ideas, which occasionally interlink and overlap but can also be seen individually in certain contexts. The discussion in section 5 attempts to consolidate these concepts and link them to one another in a cohesive manner.

Climate vulnerability

In the climate change literature the concepts of *vulnerability*, *exposure*, *sensitivity*, *adaptation* and *adaptive capacity* are highly inter-related. Their unit of analysis also ranges in scale, from the vulnerability and adaptation of an individual to the entire globe in response to a particular climate induced stressor (Smit and Wandel, 2006). Of special interest in this thesis however is the application of adaptation, adaptive capacity and vulnerability to so called social-ecological systems or coupled human-environment systems (Turner et al., 2003; Schröter et al., 2005), including communities, households and individuals.

Vulnerability to climate change, in the simplest term, refers to the state of susceptibility to harm (Adger, 2006). This state is then typically described to be “a function of three overlapping elements (Fig. 3): *exposure*, *sensitivity* and *adaptive capacity*” (IPCC, 2001; Yohe and Tol, 2002; Adger, 2003; Smit and Pilifosova, 2003; Turner et al., 2003). Exposure is generally defined as the degree to which a system experiences environmental or socio-political stress (Adger, 2006).



Figure 3. Compound elements of climate vulnerability

To exemplify in the smallholder farmer context: will rainfall variability result in more floods or droughts; will the timing of rainfall events change? Sensitivity refers to the extent to which a system is modified or affected by such stress (IPCC, 2001). For example, how many more people are at risk of getting malaria with increased rainfall? Adaptive capacity in turn involves the ability of a system to adjust to *climate change* (including *climate variability* and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences (IPCC, 2007). For example, what are people's capacities to reduce the risk of attracting malaria induced by increased temperatures?

There are (at least) two distinctive camps of vulnerability research within the climate change discourse. The first, most commonly referred to as outcome vulnerability (O'Brien et al., 2007) has grown out of various risk-hazard and impact frameworks (see Fussler and Klein, 2006). It focuses on the *impacts of climate change* in terms of measurable units on various sectors in society. The second, contextual or critical vulnerability, proceeds from the constructivist literature on entitlements and livelihoods frameworks (see Dreze and Sen 1991; Sen 1999; Watts and Bohle, 1993; Ribot et al., 1996; Adger, 2006). It focuses on the *variation and dynamics of vulnerability within and between social groups* in society thus emphasizing aspects of inequality and distribution.

Proceeding from work by O'Brien et al. (2007), I define *climate vulnerability* in this thesis as the convergence of multiple climate induced stressors and outcomes, manifested as the *limited* ability of an individual, household or community to cope with or adapt to *climate variability and/or change*. This conceptualization of climate vulnerability draws on both of the vulnerability frameworks in an effort to relate exposure, sensitivity and adaptive capacity to each other in an *integrated* manner, as called for by Hinkel (2011). Thus, while I see the element of adaptive capacity as taking precedence over the other two key elements of exposure and sensitivity within the concept of climate vulnerability their interaction within the couple human-environment system is highly important and only through an integrated approach can these dynamic interactions be understood (Turner et al., 2003; Schröter et al., 2005). Moreover my definition also directs attention to the idea of differential adaptive capacities that may enable or limit the capacities of certain communities, households, groups and even individuals to manage climate induced impacts and how these must be explored through the lens of

intersectionality (Crenshaw, 1989); whereby different various social stratifications in society including: ethnicity, gender, age and sexuality may have to be examined to differentiate between people's adaptive capacities to reduce climate vulnerability.

Adaptation

The concept of adaptation is a theoretical term that is used in the natural sciences since long. For instance, in evolutionary biology adaptation generally refers to the "development of genetic or behavioral characteristics which enable organisms or systems to cope with environmental changes in order to survive and reproduce" (Futuyama, 1979: 34). One of the more commonly used definitions for adaptation, in the climate change context, is suggested by the IPCC (2001: 982) who define adaptation as "an adjustment in human or natural systems in response to observed or expected changes in climatic stimuli and their effects and impacts in order to alleviate adverse impacts of change or take advantage of new opportunities". Pielke (1998: 159), also in the climate context, defines adaptations as the "adjustments in individual groups and institutional behavior in order to reduce society's vulnerability to climate". Smit and Wandel (2006: 282) refers to adaptation in the context of human dimension of global change as "a process, action or outcome in a system (household, community, group sector, region, country) in order for the system to better cope with, manage or adjust to some changing condition, stress, hazard, risk or opportunity". Similarly, Brooks (2003: 8) describes adaptation as "adjustments in a system's behavior and characteristics that enhance its ability to cope with external stress". A common denominator of these definitions is that adaptation is viewed as a *process* that involves *changes* in a particular system's coping range, involving various geographical scales and social agencies (Thomas and Twyman, 2005).

These system changes take place in many forms and on various levels (Frankhauser et al., 1999). Depending on timing they can either be proactive or reactive, meaning that they are motivated by predictions of an event in the future or as a response to a started event (Klein, 1999). They can also be autonomous or planned, sometimes also referred to as private or public, depending on the actors who adapt, i.e. a household or a state agency (Smit et al., 2000). Moreover, adaptations may have different spatial scope, either local or widespread and take different forms, i.e. technological, behavioral, financial, institutional or informational (Smit et al., 2000; Wilbanks and Kates, 1999; Huq et al., 2003). Disaster preparedness, building of flood trenches and

walls or state subsidies of drought resistant crop varieties are examples of proactive and planned adaptations, while disaster recovery, emergency migration and crop diversification can be seen as reactive and autonomous adaptation on various levels (Smit and Pfilifosova, 2003). It is important to note that even though the process of coping with climate stress and adapting to climate change are highly interlinked, they are two distinct processes, distinguished primarily by timescale, days and months instead of years and decades (Smither and Smit, 1997). Hence, coping refers to actions taking place within existing structures, whereas adaptation involves changing the framework, thereby reducing the need for coping (Eriksen et al., 2005).

In this thesis, and drawing on Ellis (1998) I use the term coping to refer to involuntary mechanisms that farmers employ during periods of hardship, so that, for example, after an extreme flood or prolonged drought, or other unanticipated major setbacks, a household attempts to maintain some sort of economic and social viability to avoid falling back into deeper livelihood distress. As such my view of coping goes against the traditional definition of coping used in the disaster-risk and management literature. Here coping is defined as a set of strategic activities taken by households in a particular sequence as a response to primarily external shocks (e.g. famines) to *regain* its former living standard after the crises has passed (Watts, 1983; Corbett, 1988; De Waal, 1989; Rahmato, 1991, Deveraux, 1993; Curtis, 1995). A major drawback of this definition, according to Rugalema (2000) lies in the implicit assumption that households who are coping are managing well, thus limiting the capacity to explain failures in coping, i.e. in terms of failing coping outcomes and failures in selections of coping strategies. My view of coping, subsequently, does not necessarily imply a strategic set of activities or always a positive outcome.

Instead, I see *adaptations* as strategically employed actions, or building on Swidler (1986) a constructed chain of actions, allowed or limited by the existing social and cultural context to achieve one or several goals. Nevertheless, in many instances the strengthening of coping, or the employment of numerous coping mechanisms, is still seen as an important way of facilitating climate adaptation, even though few studies have been conducted on how effective climate adaptation measures can build in practice on existing coping actions (Eriksen et al., 2005).

Adaptive capacity

Smit and Wandel (2006: 286) maintain that the linkages between the two concepts of adaptation and adaptive capacity are that “adaptations are manifestations of adaptive capacity”. In other words, adaptive capacity, in the context of climate change generally refers to the ability of countries, communities, households or even individuals to adjust to climate change (including climate variability and extremes); to adjust to moderate potential damages; to take advantage of opportunities or to cope with the consequences (IPCC, 2001). As such adaptive capacity involves the degree to which adjustments are possible in practices, processes, or structures of systems to projected or actual changes of climate (IPCC, 2001). Using this definition identifying or measuring adaptive capacity is difficult because it is directly connected to levels of human, social, economic and political dimensions of sustainable development and various physical characteristics, including climate conditions (Reid and Vogel, 2006). To complicate things further, adaptive capacities also vary depending on context and scale, i.e. the capacity to adapt on a local scale is quite different from the capacity to adapt on a national level (Smit and Wandel, 2006). For example, in an agricultural setting strong kinship networks that absorb stress on the local level may be seen as a significant determinant of adaptive capacity, while on the national level it may be the availability of state-subsidized crop insurance, a determinant reflecting the country’s stable socio-economic and political system. But even though the capacity to adapt is context-specific and can vary between and within households of the same community the scales of adaptive capacity are not independent or separate. Certainly, they are also to some degree dependent on the enabling environment of the community, whose adaptive capacity is further reflective of the resources and processes of the region (Smit and Pilifosova, 2003; Yohe and Tol, 2002).

According to Smit and Pilifosova (2003) countries with limited economic resources, low levels of technology, poor infrastructure, information and skills, unstable or weak institutions, and inequitable empowerment and access to resources are thus seen as having low adaptive capacity. Other scholars such as Grothmann and Patt (2005), question this emphasis on financial, technical, and institutional constraints as the primary determinants of adaptive capacity, and suggest that more research on the science of decision-making may be of great importance, especially when it comes to ability for autonomous adaptation. For these reasons Adger and Vincent

(2005) argue that there is as much uncertainty in the study of adaptive capacity as there is in climate change science. What is clear though is that the forces that influence the ability of the system to adapt are also the drivers or determinants of adaptive capacity (Adger, 2003; Blaikie et al., 1994; Kasperson and Kasperson, 2001; Wilbanks and Kates, 1999). For scientists, politicians and international donors, however, it is a challenge to identify these forces, no matter what the scale, and to understand how they interact between and within different spatial and temporal scales.

With this conceptualization as the departure point, I start my exploration of adaptive capacities to climate vulnerability by identifying the local assets or capabilities (Bebbington 1999; Scoones, 1998) and entitlements (Sen, 1981) (financial as well as social and political) that households and communities can mobilize and manage in the face of hardship. Then proceeding from Bebbington's work on capabilities (1999), who draws on Sen (1981, 1999), in combination with Kabeer's empirical work on empowerment progression (1999), I define *adaptive capacities* in this thesis *as vehicles*, not only to ensure *instrumental action* (to be able to cope/survive) but also as the means for *hermeneutic action* (making life meaningful) and *emancipatory action* (Habermas, 1971) whereby agents gain power to act and to reproduce, challenge or change the rules that govern the control, use and transformation of resources (Giddens, 1979). As such, in my perspective adaptive capacity, manifested in adaptation actions, is dynamic and involves three steps. First one must gain *power to access* those resources that enable survival. Second, one must gain *power to choose* the adaptation strategies that makes most sense in one's livelihood situation. Third, one should benefit from the *achievements* in terms of *outcomes* of the chosen strategy.

Arguably then, a study on adaptive capacities that merely assesses the bundles of resources that households, individuals and/or communities hold will only offer limited transformatory significance (Kabeer, 1999) because such an analysis will ignore the processes that may constrain access to the very capacities that enable hermeneutic and emancipatory action. Following this reasoning, my conceptualization of adaptive capacity has linkages to both scholarly work on 'chronic poverty' (Green and Hulme, 2005) and 'sustainable adaptation' (see Climate and Development Vol. 3, 2011). According to Green and Hulme (2005) what constitutes poverty is neither obvious nor universal but rather a real social experience possibly at odds with the abstract category of "the poor" imposed by the international community.

In the same way, I argue, are resource dependent communities in the global south at risk of being labelled vulnerable to climate change, despite inherent differences within and between people in one community. The emphasis on understanding chronic poverty through explorations of place-based social relations have advanced my own analysis of adaptive capacity to climate vulnerability by pushing me to examine the social relations within smallholder farmer communities. Guided by these ideas, I have attempted to identify those farmers within my study communities who persistently have limited adaptive capacities as a consequence of recurrent and limited economic and social mobility. Assisted by this approach, I was able to steer away from oversimplified statements about who is climate vulnerable and what constitutes climate vulnerability.

In addition, my conceptualization of adaptive capacity to climate variability and change is inspired by scholarly work on 'sustainable adaptation' (Eriksen and O'Brien 2007: 338), which attempts to examine the interface between poverty and vulnerability to climate change in an effort to identify a combined adaptation measure that contributes to social and environmental sustainability, including both social justice and environmental integrity (Eriksen et al, 2011). As such, this newer concept has great applicability to a thesis in sustainability science set in a Sub-Saharan context owing to its pronounced focus on exploring how adaptation may serve both the needs of human kind, particularly resource dependent communities in the global south, while also ensuring planetary eco-system needs in the face of climate stressors (Brown, 2011).

Sustainable adaptation

The increased attention to and funding for climate adaptation combined with the recognition that adaptation will not necessarily lead to positive long-term outcomes, but may instead cause maladaptation (Barnett and O'Neill, 2010) have triggered a discussion on the *sustainability* of adaptation as well as on the potential linkages and synergies between adaptation and sustainability (Eriksen et al., 2011). In turn the term 'sustainable adaptation' has recently been launched as a way to grapple with the intimate interactions between poverty-vulnerability-sustainability (Eriksen and O'Brien, 2007; O'Brien and Leichenko, 2007; Ulsrud et al., 2008; Climate and Development Vol. 3, 2011). Although not yet clearly defined, sustainable adaptation refers to measures that aim to respond to *both* poverty and vulnerability to climate change. Three key arguments for combining adaptation and sustainability are

highlighted in this debate. First, climate adaptation may address some of the historical insufficiencies of conventional social and economic development pathways that have led to increased environmental degradation and social inequity in the global south (Ulsrud et al., 2008). Second, people most vulnerable to climate change are simultaneously facing other multiple stressors that affect their well-being, which cannot be addressed by climate adaptation alone (Eriksen et al., 2011). Third, there is an urgency in ‘getting adaptation right’, otherwise there may be a risk of exacerbating the problem and disproportionately burdening those already most vulnerable to climate change (Barnett and O’Neill, 2010; Eriksen et al., 2011). As such, sustainable adaptation, in comparison to conventional adaptation approaches tries to incorporate both intra and inter-generational dimensions of sustainability by attempting to both reduce poverty and/or vulnerability to climate change, without compromising long-term sustainability and the ability of people and/or the environment to respond to climate change or other stressors (Brown, 2011).

According to Eriksen and O’Brien (2007) there are three major dimensions of vulnerability to climate change that are closely related to poverty, and thus well-being, here defined as having the ability to feed, clothe, and shelter yourself and your children, as well as to provide them with the health care and education necessary for avoiding poverty in the future (Okin, 2003). The first relates to the physical risks caused by various climate stressors, including extreme and gradual changes in weather (e.g. droughts, floods, frequency of storms etc.) that threaten not only human life but may also contribute to a failure to secure well-being. The second relates to the abilities of people (i.e. their adaptive capacities) to respond to these risks. The third involves the socio-economic and environmental processes that may exacerbate risks and/or limit adaptive capacity.

By exploring these linkages Eriksen and O’Brien (2007) argue that it may be possible to identify where the factors and processes that generate both vulnerability to climate change and poverty in a specific place based setting overlap, i.e. “the factors that lead to failure to secure well-being in the context of climate related stresses” (2007: 340). It is also in this interface the opportunities to alleviate poverty through reduction of vulnerability to climate change and vice versa are supposedly found (Ulsrud et al., 2008). Figure 4 gives a conceptual overview of the relationships between vulnerability and poverty and the area to be targeted by sustainable

adaptation measures. It should be noted here that while many poor people are also vulnerable to climate change there is no direct correlation between the two. Indeed the experiences and states of vulnerability are differentiated, and thus the size of the overlapping area of the top circle will invariably change depending upon the particular social, economic, political and environmental conditions and dynamics found in each specific setting (Eriksen et al., 2007).

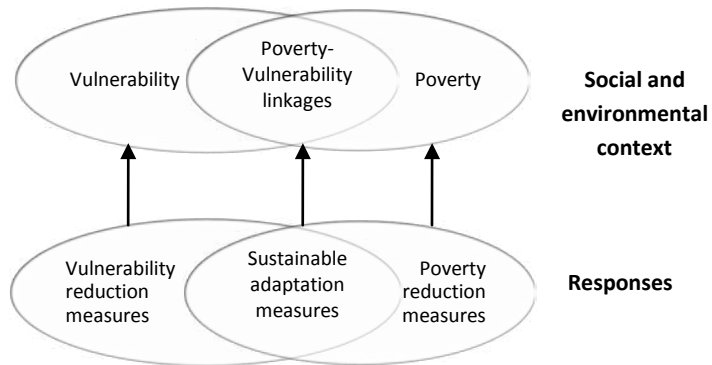


Figure 4. Conceptual overview of vulnerability-poverty linkages and sustainable adaptation measures (Source: Adapted from Eriksen and O’Brien, 2007)

To summarize, my conceptual framework combines the emphasis on social relations in the chronic poverty literature with the conceptualizations of:

- 1) Adaptive capacities as vehicles for instrumental, hermeneutic and emancipatory action,
- 2) Adaptation as deliberate and strategic chains of actions
- 3) Sustainable adaptation as policies attempting to serve both the needs of human kind, while also ensuring planetary eco-system needs in the face of climate stressors today and in the future.

As such, my framing of climate vulnerability in this thesis attempts to go beyond general explanations of its immediate causes and effects. This implies a shift away from representations of climate vulnerability as mere conditions toward a more inclusive perspective that takes into account the relations which *produce* those conditions as well as potential *ways of improving* conditions to build more sustainable livelihoods.

3. Research approach and process

Doing sustainability science

A major goal in sustainability science is to understand human–environment systems as integrated (coupled) rather than separate or even separable entities (Schröter et al., 2005; Clark, 2007, Kates et al., 2001). Accordingly, advancing this understanding requires interdisciplinary research whereby all, or at least many, aspects of environment-society relations are explored (Ziegler and Ott, 2011). Subsequently, sustainability scientists are required to draw upon a wide range of research areas and tools from both the social and the natural sciences, including but not limited to, complex systems theory, cultural and political ecology, scenario making techniques and coupled modelling (Clark, 2007; Ziegler and Ott, 2011). This does not imply, however, that every piece of research, or a thesis like this, must employ all such tools simultaneously.

Another major distinction between SS and other research fields relates to the inclusion of non-scientist into the research process. By acknowledging that HES are complex and continuously in flux, we draw upon many different ways of knowing and learning in SS, whereby the inclusion of non-scientists opens up the possibility to consider local and tacit knowledge (Kates et al., 2001). Involving non-scientist, or in my case, smallholder farmers and others working directly with farmers, opens SS to relevant, significant and contingent knowledge about the local context. It also facilitates problem formulation and helps in contextualizing knowledge application, which arguably may contribute to the normative goals of SS by improving viable policy and implementation outcomes (Ziegler and Ott, 2011). For these reasons SS is neither 'basic' nor 'applied' science but rather a 'use-inspired basic research' field (Clark and Levin, 2010: 88).

My attempt to apply a sustainability science approach in my research has not always been easy and straightforward. First of all, my research process has been affected by the fact that I had no previous knowledge or experience from the African continent before embarking on this research journey. Hence, my first encounter with Kenya was in November 2006 when I attended the UNFCCC COP 14 meeting in Nairobi and with Tanzania in September of 2007 during my first fieldwork.

Moreover, as mentioned in the introduction we are all biased towards our academic history and this tends to color our ways of doing and thinking about research, whether we are conscious of it or not. In my case, this has influenced *how* I collect my data, which in turn affect *what* I am able to see in my data. Moreover my past experiences also influence what I *can* see, or as Kathy Charmaz (2006: 15) aptly puts it;

We are not scientific observers who can dismiss scrutiny of our values by claiming scientific neutrality and authority [...] researchers are obligated to be reflexive about what we bring to the scene, what we see, and how we see it.

So too are sustainability scientists' responsible for reflecting on their own research process and outcomes (Kates, 2011).

Research design and strategy

This research project mainly relies on qualitatively collected data from various types of individual and group interviews. But it also includes certain crucial quantitative information such as data from a household survey and local rainfall data. Consequently, the study is firmly rooted in an interpretative research epistemology (Mikkelsen, 2005). Primarily I proceed from the study subjects' knowledge and experience (here smallholder farmers) to induce and generate conceptual tools that are used to interpret and structure the empirical data in an iterative process. As such, the study is predominately, but not exclusively, based on a qualitative research methodology where I seek to understand and explain *the reasons for and the dynamics of* the phenomenon under study (Flick, 2006), namely climate vulnerability, rather than measuring or quantifying the existence of it. Accordingly all participating respondents were selected purposively (Flick, 2006), i.e. based on who would have the most to contribute for the topic to be discussed, and then theoretically (Charmaz, 2006) as the analysis progressed according to their (expected) level of new insight for the development of the concepts investigated.

Throughout the research project a great emphasis has been placed on including and having smallholder farmers themselves participate in as many aspects of the research project as possible. Not only has this given me the opportunity to test, evaluate and verify empirical findings along the way but it has also enhanced the iterative process (Chambers, 2008) by allowing me to revise the empirical data throughout the duration of the project.

Moreover the inclusion of local stakeholders, beyond smallholders, has facilitated my problem formulation and assisted me in contextualizing empirical findings, and thereby improving my understanding and potentially the applicability of my research conclusions.

Participation however, requires trust and in order to build that trust I deliberately decided to return to the same households and community groups again and again. Accordingly my sample size is quite small, but by interviewing the same farmers several times in various different ways and with different focus every time, I have instead been able to revisit crucial issues and questions, thereby allowing for ‘unexpected’ findings (Chambers, 2008). This hopefully has made my contextual account of climate vulnerability more detailed and integrated.

Table 1 below summarizes the data collection strategy of the entire research project, including different fieldwork periods and methods utilized.

Table 1 – DATA COLLECTION STRATEGY 2007-2011	
Field work periods	Methods used
<i>Pre-study 2 weeks</i> <i>November 2006</i>	<i>Informal Interviews</i>
1. Sept and Oct 2007 2 months	Semi-structured interviews Exploratory household survey
2. Oct and Nov 2008 2 months	Informal open-ended interviews Narrative walks Episodic interviews Focus Group Discussions Collecting of precipitation data
3. September 2009 2 weeks	Interactive seasonal calendars Focus Group Discussions Informal open-ended interviews Collecting of precipitation data
4. January 2010 2 weeks	Multi-stakeholder workshop Focus Group Discussions Informal open-ended interviews
5. January 2011 3 weeks	Focus group discussions Informal open-ended interviews

Fieldwork methods

The bulk of data upon which this thesis is based thus comes from the different types of interviews I have conducted, with smallholders, local politicians and stakeholders from within and outside the community as well as so called 'experts' in the field (i.e. scholars, development practitioners etc). The most valuable empirical data in the study obviously comes from the farmers themselves, since it is their lived experience and interpretation of climate vulnerability that is the main focus of the research. Most of the interviews and focus group discussions with farmers were conducted in local dialects, with the assistance of a locally hired translator versed in the specific dialects required for each country. The information provided by the interviewees were translated directly during the interview, tape-recorded and later transcribed verbatim on my lap-top computer for further analysis. Dependency on different translators has however inhibited my capabilities of 'reading' the cultural landscape of daily life in the LVB. It may also have affected some interview outcomes, because of whom and also where the translator originated from, if it was a woman or a man or if she/he came from the city or a village nearby. Moreover, at times, due to timing and availability, there was a lack of consistency in the use of translators for certain tasks at different junctures in the research process. This may also have affected the depth of the interviews, because of lacking trust or misinterpretations. All in all I recruited six different translators, three in each country. Two of them were recruited several times, both because they were good at what they did but also because they were genuinely interested in the topic.

Another important source of information for advancing my fieldwork comes from the numerous informal conversations I have had with people, while sharing a meal in a restaurant, shopping in the local market or during transport between different houses or communities. By acknowledging the virtue of taking it slow and easy (*pole pole*) and relearning the value of having these casual conversations with people I have been able to gain valuable insights on the 'subtleties' of local norms and culture in the basin. Information that later have assisted me tremendously when attempting to disentangle and analyse people's answers and actual behavior.

My first meeting with rural locals in Kenya and Tanzania involved a great deal of outspoken curiosity about me as a person and how my presence in their community could aid in some way. This 'expectation' made it crucial, early on

in the fieldwork, to explain, not only the *purposes* of my research but also its *limitations* in order to build trust and prevent disappointment about participation in the research and the potential outcomes for them. On the positive side this keen interest has sparked a great deal of fascinating discussions, as well as some misunderstandings, primarily linked to variations in social norms. Of special interests to people is my lack of tribal kinship and religious affiliation, my vegetarianism, and the contrasting gendered responsibilities that my husband (who often accompanies me in the field) and I often display in the communities, whereby he assumes the primary parenting role for our daughter and I assume the professional researcher's role. Although these differences between 'me' and 'them' at a first glance may appear impossible to overcome, the presence of my family has actually helped in closing that gap by showing farmers that I too am like them, i.e. first and foremost a parent wanting to provide for my family. I believe that this knowledge about my person has made it easier for me to gain people's trust and honesty in the interview situation, especially from women.

Returning and re-visiting the same communities, and even most households, every year from 2007 to 2011 has also aided in sustaining that trust with participating farmers. By making a point of reiterating what we did last time we saw each other and disseminating some of my initial analysis at each revisit I have also attempted to make it easier for the participating farmers to feel included into the research process (Chambers, 2008).

A huge advantage for me in doing fieldwork in this region is related to my affiliation with a well-known, established and respected non-governmental organization (NGO) in the basin, VI-Agroforestry, who assisted me in getting in contact with local leaders, other key actors in the communities as well as facilitating my transportation needs between the two countries. Upon entry into the communities, this affiliation made it possible for me to gather community members to introduce myself, my research agenda as well as get an insight into problems confronting the farmers in each community. In the course of these meetings, I was then able to identify with guidance of community leaders and VI-Agroforestry staff, respondents for my initial interviews as well as groups of farmers willing to participate in the first round of focus group discussions.

Interviews

For me as a researcher the purpose of conducting an interview is naturally to gather data. With that in mind I also have to acknowledge that interviews, to an extent also are interventions (Patton, 1990), because the conversation I engage in and the questions I ask will inevitably affect those that I talk to. During some of the interviews the intervention element became quite obvious, especially those interviews conducted one-on-one, without an interpreter and relating to topics that involved personal tragedies, such as becoming a widow, living with HIV, social exclusion, facing hunger or domestic violence. These interviews were powerful both for me and my respondents and in no way would they have been possible without a mutual understanding and respect for one another.

Semi-structured interviews

In order to get an overview of key problems and challenges of the region as a whole in relation to predicted climate change, its potential impacts on smallholders' in the LVB and existing response strategies I had to begin my research journey with interviewing key informants. The respondents in these semi-structured interviews came from various universities, research institutions, international NGO's and development agencies familiar with the geographical context and/or the concepts under study (e.g. UNEP, Sida, CARE, ILRI, ICRAF, CEEST, ACTS, University of Nairobi and Dar es Salaam respectively). Building on this knowledge and a few open-ended interviews with randomly sampled farmers in Nyanza and Mara I then constructed and designed my household questionnaire.

Exploratory household survey

The purpose of the baseline household survey (EHS) was to explore current livelihood conditions by examining demographics, livelihood activities and assets, agroforestry practices, experienced changes in weather, impacts of droughts and floods on household security, coping mechanisms after flood and drought and type of assistance from the outside. The study communities were selected on the basis of their susceptibility to floods and/or drought and subsequent households were sampled randomly within these locations based on their willingness to participate. I designed the format of the survey with input from VI-Agroforestry, familiar with carrying out similar surveys among farmers. Due to high illiteracy in the area and poor local language skills on my part I recruited four field assistants, well versed in the local

dialects, to assist me in conducting the survey interviews. In every country I first piloted the survey questionnaire on ten households in a village outside of my study area before commencing the actual survey. These pilot survey interviews were conducted together with the selected field assistants to observe them in action and see what types of problems that could emerge. The EHS questionnaire (see Appendix 1) was then revised to eliminate and avoid asking questions that proved either unnecessary or could be misunderstood by respondents.

The survey covering 600 farming households in 11 locations across Mara and Nyanza (Fig. 1) took six weeks per country to complete (approximately 10 HH were interviewed per day) and this was conducted concurrently during four weeks in both countries after I had piloted the study in one country first and then the other. Everyone in a household was allowed to respond to the questions asked. Hence, the duration of each survey interview ranged between 30 to 60 minutes depending on how much discussion each question incited. The survey was also designed in such a way as to give respondents the opportunity to tick more than one answer to many of the questions asked. That made the questionnaire much more open-ended and qualitative in style.

I only participated in approximately 20 of the total 600 survey interviews, primarily because of the inhibitions that my presence could possibly cause but also due to the remoteness of some communities, which constrained transportation options. And since I was five months pregnant at the time and had limited experience with driving a motorcycle I decided that it was not worth the risk.

Narrative walks

During the fieldwork period in 2008 I conducted four 'narrative walks' (Olsson and Jerneck, 2010) with location chiefs/ward executive officers from the four locations/wards selected as the primary study sites. These walks had the purpose of constructing 'cross-sectional maps or diagrams' (Mikkelsen, 2005: 90) of the specific local setting. Included in these 'maps' were landscape characteristics, the whereabouts of certain livelihood activities in the village and location and availability of specific natural resources used by households. These maps also included spatially marked problem areas in the village (e.g. flood prone and deforested areas, extensive gullies) and discussions on what type of interventions that has taken place to deal with

these spatial problems. While walking and scribbling on my cross-sectional map I concurrently conducted informal interviews with the chiefs. Topics discussed related to the availability of and access to local formal and informal networks, types of assistance given by the local government to community members, as well as linkages to networks beyond the locality.

Episodic interviews

Using the episodic interview method (Flick, 2006: 181) I also conducted 17 interviews with randomly selected elderly farmers (above 60 years of age) to explore change over time. There was no rigid sampling process for these interviews, i.e. those elderly farmers who were found and agreed to partake in the study were interviewed. A central idea in this form of interview is to recurrently ask the respondent to present narratives of specific situations or experiences from their life based around a number of topical domains that I selected beforehand. In this case, the topical domains revolved around changes in livelihood activities, climate parameters, livelihood security and changing gender roles in the economy of affection (Hydén, 1983). The advantage of this type of interview method is that it is not necessary to go through a single overall narrative, which is very time consuming, but rather it stimulates several limited narratives while at the same time the interviewer can intervene and focus the interview back to certain topics. A disadvantage however, is that probing of social interactions are limited. But in my case this could be covered through focus group discussions.

Focus group discussions

I facilitated a total of 12 focus group discussions (FGDs) in six out of the total 11 study sites initially covered by the household survey. I selected these locations on the basis of findings from the narrative walks, episodic interviews and results from the household survey. These FGDs were constituted on the basis of both gender and memberships in various formalized collective action groups. Although the number of participants in the FGDs ranged between 6-30 participants, an average of 8 people participated per session. The FGDs required an average of 2 hours of formal session to conclude.

The choice of using the focus group as a recurrent interview method throughout the project comes from the advantages of combining the *group interview*, whereby several people discuss a number of topics together, with

the *focused interview*, in which a specified theme or topic is explored in depth (Bryman, 2008).

The first round of FGDs concentrated on the impacts of extreme droughts and floods on natural resources and family well-being as well as the coping mechanisms employed during or after such periods/events. By conducting this in a group setting I could also reflect on how respondents debated about the concepts of coping and adapting.

The second round of focus groups focused on collective farming activities, mutual engagement and collective responsibilities, village-saving and loan schemes and income-diversification practices.



Photo 1-2. Focus groups with female farmers in Kakola (left) and Onjiko (right), Kenya. (Photos by: Andreas and Sara Gabriellsson)

The third and final round focused on the situated knowledge and individual experiences of being a widow in Luo culture and how to respond to changing livelihood conditions. I used a snowball sampling technique (Bryman, 2008) for the interviews and FGDs focusing solely on widows whereby one widow assisted in providing information leading to the identification of another widow in the community, etc. The interviews and FGDs with widows were conducted with the aid of a guide. The data sought centred on socio-economic characteristics of the widows; factors influencing poverty among the widows; coping mechanisms employed by the widows to sustain themselves and suggestions on what can be done to improve their living conditions. These in-depth interviews required an average of two formal meetings to complete.



Photo 3-4. Focus group introductions in Kisumwa ward, Tanzania (right). Discussions with my translator Deus Cosmos, Musoma, Tanzania, (left). (Photos by: Andreas Gabrielsson, 2008)



Rainfall data

When I initiated the research for this thesis few local studies on climate variability and potential change had been conducted in close vicinity to my study sites. I therefore decided to collect rainfall data myself from available meteorological stations in both Nyanza and Mara. But getting my hands on the precipitation data proved to be more difficult than I had anticipated. In hindsight I realize that I was fairly naive about the whole thing. Indeed had I done research in East Africa previous to this study I probably would have found other channels to obtain such data and hire someone to compile and analyze the data for me, instead of doing it myself, despite my limited knowledge. In addition, acquiring the data was expensive, in total I probably spent 8000 SEK for the data (a considerable amount for a PhD student on a tight fieldwork budget), most of which was spent on daily rainfall data from Kisumu airport. Moreover, data was also incomplete and missing. Out of the total six meteorological stations that I collected data from, only two (Kisumu and Musoma airport) proved to be viable for analysis, since the others had data gaps of days, months and even years during some periods (!).

Interactive mapping of seasonal calendars

Based on the combined findings from the household survey and the interviews it became clear that smallholders faced a multitude of stressors, some of which were linked to climatic factors, especially rainfall. However, it

was not clear how these factors related to one another, over time and the type of feedbacks that developed because of them. Hence in 2009, together with a colleague (Sara Brogaard) from LUCSUS we went back to the primary study sites to ask farmers to describe and map, in smaller groups of 5-7 people, their annual pattern of livelihood activities and stressors including: climate (rainfall and temperatures), health (disease affliction), food consumption (degree of insecurity) and expenditures (on basic needs, including food). Moreover they also had to map their agricultural and animal husbandry activities and the annual distribution of on- and off-farm incomes. The seasonal calendars (Desai and Potter, 2006) were then discussed larger groups, of up to 30 people, to clarify meanings of words etc. Day two after the finalized calendars had been translated into English and redrawn by me, we went back to the groups to share the compiled calendars and discuss the convergent periods.



Photo 5-6. Introducing the seasonal calendar exercise in smaller groups in Kunsugu, Tanzania. (Photo by: Sara Gabrielsson, 2009).

Multi-stakeholder workshop

In the spirit of stakeholder participation and inclusion, I also planned and organised a multi-stakeholder workshop in collaboration with VI-Agroforestry in January of 2010 (Appendix 2). The two day workshop was held in Kisumu, Kenya and over 50 people from a variety of sectors participated. The focus of the workshop was livelihoods and climate vulnerability in the Lake Victoria Basin. Special emphasis was put on including regional stakeholders (e.g. financial institutions, universities, NGO's, private companies and government) working in the basin from both Kenya and Tanzania, including some farmers from the study communities. The objective of the workshop was twofold. First it aimed to raise awareness and open up a dialogue

between scientists, policy makers and those working closely with communities most vulnerable to climate impacts. Second, it also served to increase collaboration between high-end stakeholders themselves as well as between them and local farmers. The workshop was arranged to include both plenary and group sessions that focused on key climate vulnerability problems, future scenarios for smallholders and the role of actors and actions. I both presented and acted as a facilitator in group-sessions during the workshop. A workshop declaration (Appendix 3) was written and later presented by some participants from the workshop to representatives of the East African Community (EAC).

Data analysis and integration

As previously stated most of my empirical material is based on qualitative data, in the forms of field notes, recorded audio files, interview transcriptions, seasonal calendars, workshop group session summaries, photos from focus group discussions and local newspaper articles. Organizing this empirical data was a challenging task, especially after the first fieldwork period in 2007, when I was overwhelmed with impressions and thus had a difficult time seeing the forest because of the trees. While the semi-structured interviews with key informants assisted me in downsizing my research topic and delineating my research questions I still did not have enough data to start my analysis. Moreover, due to risk of pre-eclampsia at the end of my pregnancy my doctor banned me from work until the delivery of our baby. Hence I went on sick-leave almost immediately after the first fieldwork period in November of 2007 and did not get back to my household survey data until March of 2008 after the birth of my daughter Agnes.

So, after receiving the raw data by airmail from East Africa I first spent six weeks transferring the data into SPSS. I then analyzed household survey results for their frequency and distribution across the various study sites to locate communities who were perceived to be the most exposed to floods and droughts and where weather was experienced to have changed in recent years. These locations were then selected for further qualitative in-depth study. Results from the survey have later also been used to uncover demographic specifics, differentiations between livelihood conditions of female and male-headed households as well as for identification of communities with high numbers of widows and their livelihood characteristics.

Using thematic analysis (Bryman, 2008) I first searched the FGDs summaries and notes for commonalities and differences across groups. This allowed me to categorize the various coping mechanisms based on their thematic, spatial and temporal characteristics. Similarly, interview transcripts were scanned through to identify recurring themes that later could be clustered into and merged into larger themes. Common themes included rainfall changes, coping mechanisms, farmers' experience of change related to natural conditions, food insecurity, diseases, prices, labor burdens, micro-credits and loans, gender and tribal norms, collective action over time, as well as agricultural practices. However, while analyzing the qualitative material initially seemed straightforward and easy, I soon realized that I had too many themes to work with and no direct linkages between them. Moreover the reported changes in rainfall varied markedly between farmers, and these in turn could not be linked to other emerging themes from the interviews and FGDs. Hence, I needed to both find new themes for further analysis and find evidence of some change in the rainfall pattern from my collected precipitation data, which later also made sense in relation to the qualitative data.

But analyzing the precipitation data collected from Musoma and Kisumu proved to be a difficult and time-consuming task for a novice like me. First I had to compile the data from Musoma into an excel sheet, since the retrieved data was only available in photocopies from the actual precipitation log book. Entering this daily data between the years of 1959-2008 into a computer file thus took several weeks to complete. My *basic* rainfall analysis also took time, especially since actual changes in rainfall patterns proved to be complicated to find. Consequently, frustration started to wear on me. Juggling motherhood and taking unsatisfactory PhD courses, switching supervisors in combination with analyzing complex rainfall data without results finally took its toll. I was emotionally drained and wanted out. Shortly after this I was diagnosed with depression. I stayed on sick leave for most of the spring and summer of 2009. When I finally did go back to work in September of 2009 it was only in a limited capacity. Upon recommendations from my therapist I continued to work on a part-time basis throughout 2010.

My first real attempt at getting back into my PhD research came upon receiving funding to go to East Africa, to carry out the interactive seasonal calendars with a research colleague. This fieldwork period gave me back some of my passion for research. It also inspired me to make another

attempt at analyzing the rainfall data. In the end, and with a lot of assistance from my research colleague, the collected precipitation data was used as a proxy for the study sites in Kenya and Tanzania, even though data was not uniform across the two and they were located from between 10 to 40 km from the study sites.

The six topic areas for the calendars including: 1. climate; 2. disease affliction; 3. food consumption; 4. expenses; 5. farming activities; 6. on- and off-farm incomes were first combined per group and compared, then combined per country and compared. Lastly, the calendars from all study sites were combined, reworked and redrawn digitally to illustrate a generalized convergence of stressors. These findings also aided in revisiting interview transcripts from 2008 by looking for code words that had emerged during FGDs. From this specific analytical themes emerged (Flick, 2009) and a narrative started to take shape from which I now could start to build my conceptual framework with complementary academic literature. These initial findings were then tested at the multi-stakeholder workshop in January of 2010. The last empirical piece of my puzzle was finally added after interviews and FGDs with two groups of widows in Onjiko in early 2011. Upon analyzing this new material together with the other already analyzed data through theoretical sorting (Charmaz, 2006) I could now integrate my findings and refine the theoretical linkages to the literature. This subsequently shaped my narrative of climate vulnerability, which allowed me to finally begin to write my 'story'.

Ensuring research quality

All research focused on climate change, this study included, involves elements of complexity and various degrees of uncertainty due to the interaction between social and natural systems on various temporal and spatial scales. A consequence of this is that the reliability and validity of the research may be questioned. In such circumstances, and to ensure that this thesis lives up to scientific scrutiny, this study can be assessed by its trustworthiness (Guba and Lincoln, 1989), rather than reliability and validity. Trustworthiness is evaluated on the basis of three criteria, each of which has an equivalent criterion in quantitative research. In detail these relate to: First, the *credibility* of the findings, which are made more trustworthy if they come from results based on more than one research method (triangulation), which I ensure through the use of a multitude of methods, tools and techniques; including interviews, survey, participatory mapping, rainfall data and a

stakeholder workshop. Second, the *transferability* of the results, which are made trustworthy because of the thick accounts, in terms of detailed descriptions and analytical understanding that the qualitative researcher can present of the studied phenomenon through the use of verbatim citations from the gathered empirical data, whereby the relevance of the evidence and the use of findings in other settings are increased. I ensure this transferability by giving many of my respondents a voice through direct citations from interviews in several of my articles. Third, the *dependability* of the data collected, which involves keeping a strict and transparent record of the entire research process and all the gathered material to not only foster confidence in the data but also to make it possible for other researchers to imitate the techniques used, thereby making it reliable. Dependability in my study is ensured through written field note books, recorded sound files and written transcripts from the majority of the conducted individual interviews, photos from participatory exercises, saved raw data from both survey and rainfall records as well as the compiled SPSS file containing all the questionnaires and excel sheets of basic rainfall analysis.

4. Study context and setting

History matters – old and new realities for smallholders

In order to understand the struggles of smallholder livelihoods in the LVB today it is necessary to place smallholder farming into a historical context. Four developments with particular significance for smallholder farming systems across SSA are emphasized here; the partition of Africa, the introduction of agrarian division of labor, the failure of African socialism and structural adjustment programmes. The first relates to the 'scramble for Africa' following the Congress of Berlin in 1884-85, which partitioned the continent among European powers and thereby created borders that cut through 177 natural ethnic or cultural groupings (Caplan, 2008). Despite partitioning or perhaps because of it, original ties of ethnicity and clan grew stronger during colonial rule and these still remain strong today, especially in rural areas (Caplan, 2008). While much of SSA today have recovered from the physical colonization and policies that undermined Africa's economic, infrastructural, educational and technological development (Rodney, 1973; Hydén, 1983; Caplan, 2008) many African's are still affected by the remnants caused by the colonization of their mind, which, it is argued, instilled in them a sense of inferiority and backwardness (Maathai, 2009). According to Nobel Laureate Wangari Maathai this has created a lack of 'self-knowledge' (2009: 170) among Africans, by which they are allowing themselves to be exploited by their leaders and to being exploiters themselves, without confronting their own agency and choices. This subsequently also has implications for the way in which smallholders' in the LVB react to and respond to contemporary changes in climate.

The second historical development with impacts on smallholders can be linked to the introduction of Christianity into Africa during the colonial and post-colonial era which lay the groundwork for patriarchal family structures and the generic ideal of the nuclear family in which senior males came to be heads of households and seen as bread-winners, while women were idealized as being responsible for taking care of the home and children (Mies, 1986). This in turn led to agrarian division of labor, still at work today, whereby male farmers engage in cash-crop production, while females are responsible for subsistence production (Francis, 1998).

The third historical development which I argue have had importance for shaping the struggles among smallholder farmers in the LVB today relates to

the failures linked to the post-colonial projects of African Socialism in the 1960s and 70s in Tanzania and Kenya. In Tanzania African socialism was interpreted by president Julius Nyerere to involve ‘tribal villagization’ driven by *Ujaama* (i.e. familyhood), whereby all of Tanzania was to be established and run by nuclear families living in small decentralized villages based on democracy, social welfare, mixed economy and independence. In reality however, the massive reorganization of the Tanzanian countryside, which forced many rural farmers away from their place of origin demoralized many farmers (Lal, 2010). Similarly in Kenya, Kenyatta’s version of African Socialism ‘Harambee’ (i.e. let’s pull together) was used as a political and economic tool to develop the country by exploiting rural communities to work for free and collect capital to build local schools, health clinics or roads etc. (Dubell, 1994). This may help explain why farmers in the LVB still express reluctance to engage in collective activities that go beyond their own communities or are instigated by the government.

The post-independence era after the failure of African socialism saw a lot of political turmoil and instability across East Africa with dwindling economic development as a result (Bryceson, 2002a). Eventually this led to the introduction of structural adjustment programs (SAPs), which I argue is the fourth historical development with special significance for smallholder farmers across SSA. In Kenya and Tanzania SAPs were introduced from the mid-1980s to the mid-1990s (Ellis, 2000). Structural adjustment amounted to serious impacts on most smallholders’ livelihoods through the removal of subsidies on improved inputs such as fertilizers, seeds and pesticides (Bryceson, 2002a). In addition SAPs dismantled the African marketing boards and para-stats, which had been in charge of servicing smallholder agricultural production input requirements, through enforced commodity standards, provision of single-channel marketing facilities and controlled prices (Bryceson 2002a). These changes resulted in a more uncertain market environment, where producer prices were subject to wide fluctuations, input prices skyrocketed and supply became tenuous as most traders did not have the rural outreach of the parastatals they replaced (e.g., Jambiya, 1998; Madulu, 1998). Consequently farmers had to switch to crops with quick or regular year-round returns (Bryceson, 2002a). Bankrupt African governments also removed subsidies on educational and health services. Hence, school fees and user fees at health centers became a high priority of smallholders’ household budgets (Bryceson, 2002a; Ellis, 2000; Francis, 1998).

The repercussions of SAPs on rural agricultural production have been many. The single most important of these for smallholders however has been the rapid decline in men's labor time and economic returns from cash-cropping (Francis, 1998). Not only has this forced able-bodied adults as well as many children to seek income-earning opportunities to prevent impoverishment it has also undermined men's role as family providers (Francis, 1998). Ultimately SAPs have led to significant changes in the organization of labor in rural areas, whereby agricultural work now has become increasingly replaced by non-agricultural work, unpaid work has become paid and activities formerly performed by a household is now usually carried about by an individual (Francis, 2000; Ellis, 2000; Bryceson, 2002b). For many families these drastic changes have also had negative effects on the long-standing agrarian division of labor as well as economic rights and responsibilities within smallholder households (Francis, 1998).

While these historical changes are still at work in rural areas across SSA socio-economic processes are now being propelled by first; the aftermath of the HIV/AIDS pandemic, which has left numerous rural farming communities food insecure and labor exhausted (Bryceson and Fonseca, 2005; Gillespie, 2006) and secondly; by economic globalization, which is flooding SSA rural markets with foreign goods and services, primarily from China (Miles, 2007). The outcomes of these old and new socio-economic transitions on smallholder farming systems has resulted in a more cash-based economy and a radical shift away from subsistence farming, toward the emergence of what Bryceson refers to as 'multiplex livelihoods' in rural areas of SSA (Bryceson 2002b: 2). This type of agricultural livelihood system compels rural farmers to diversify non-farming activities in a saturated non-skilled job market to generate cash to secure a basic livelihood, in an economic market place filled with imported goods. According to Miles (2007) this, so called, 'quasi-development' thus leaves many Sub-Saharan Africans having an increased need for cash but with limited means to generate it.

The landscape of the Lake Victoria basin

The Lake Victoria basin (LVB) is located in the upper reaches of the Nile River basin (0°21'N – 3° 0'S; E) and occupies an area of about 251,000 km² of which 69,000 km² is the lake area (UNEP, 2006). It is Africa's largest freshwater lake and also the second largest in the world. The lake draws 20% of its water from surrounding river networks, including Kagera, Mara, Simiyu, Gurumeti, Yala, Nyando, Migori and Sondo-Miriu rivers but over 80% comes

from direct rainfall (UNEP, 2006). Three countries share the lake's surface area, Kenya (6%), Tanzania (49%) and Uganda (45%) but its tributary waters are also shared by Rwanda and Burundi (Shepard et al., 2000). The size of the lake and its location has great importance to the region and the globe for many reasons, including its role as: the largest inland water fishing sanctuary, an important inland transport route between the East African countries, a major source of water for both domestic, industrial and agricultural purposes, a generator of hydropower, a climate modulator in the region, a biodiversity hotspot, a major source of livelihood assets and activities to the people living in and around the lake (Odada and Ochola, 2009).

The lake basin supports one of the densest (150-1200 people/km²) and poorest rural populations in the world (UNEP, 2006), and most of them are heavily concentrated near the lake. The population exceeded 30 million in 2001 and this number is expected to grow rapidly and reach 53 million by 2025 (Wandiga et al., 2006). A multitude of challenges are facing people living in the Lake Victoria basin today. Many of these are related to and driven by the current state of the environment and how this will change in the future. According to Fuggle (2002) some of the contributing factors to the predicament of the basin are the consequence of decisions and policies made in far parts of the world, formerly by colonial powers and more recently by global economic structures. But other driving forces are cultural, ecological and geographical and require detailed understanding of the lake basin in terms of its "anthropology, biology, communities, demography, economy, geography, hydro-graph all the way to zoology" (Fuggle, 2002: 1).

Land and water – natural resources in decline

Land is considered the most critical resource for the survival of inhabitants in the basin, since most livelihoods are dependent on some form of agricultural activity (UNEP, 2006). But land degradation is widespread in the region, indeed an estimated 150,000 km² of land has been affected by soil degradation since 1980 including as much as 60% of agricultural land (Swallow et al., 2002). Water and wind erosion, nutrient depletion, salinization, acidification, compaction and/or deforestation are the main contributing factors to land degradation in the basin (UNEP, 2006). In many cases these negative outcomes have direct linkages to human-induced driving forces, such as population growth and poverty which puts pressures on expanding the availability of agricultural land by clearing natural habitats and cultivating marginal lands (Odada and Ochola, 2009). Overgrazing,

unplanned infrastructure development, continuous mono-cropping, poor farming methods and uncoordinated provision of extension services are some of the other causes of land degradation in the basin which are threatening the livelihood security of its inhabitants (UNEP, 2006).

Land is also being affected by the use and misuse of forests and woodland areas in the basin. Certainly, forests and woodlands reduce soil erosion, impede surface runoff and provide valuable endowments to people's livelihoods in the form of medicines, fruits, building materials, firewood and fodder to name a few (Swallow et al., 2009). But deforestation is still common in the LVB as increased demand for charcoal is growing among the rural population. Naturally and socially induced events like fires, floods and landslides also contribute to deforestation (UNEP, 2006).



Photo 7. Primary freshwater source at the bottom of a gully in Thuridibuoro (Photo by: Sara Gabrielsson, 2008).

Freshwater is another vital resource for the sustainability of the basin. As mentioned before the lake has vast freshwater resources, both from surface and groundwater sources but there are also a lot of pressures put on these resources, especially linked to population growth and consequent livelihood

activities associated with farming and urbanization. As a result Lake Victoria's water ecology is deteriorating, and this is being documented especially related to a decline in the quality and quantity of water and increasing number of conflicts over water resources (UNEP, 2006). The quality of water is deteriorating both because of the large discharges of untreated sewage and chemical wastes from urban centres as well as from micro-bacterial and nutrient-rich runoff from pastoral agricultural lands, shrub-lands, forests and municipal slums (UNEP, 2006).

In addition, pesticides used in fishing and farming along with the utilization of mercury and toxic cyanide in mining activities are also contributing factors (Campbell, 2000). Direct results of the degradation of water quality are increased incidence of water borne diseases as well as eutrophication causing seasonal anoxia and the death of fish and plants species in the lake (Hecky et al., 1992; Wanding, 2006). Deforestation and unsustainable agricultural practices has also led to an accelerated rate of sedimentation which has started to reduce the inflow of water from surrounding rivers, potentially exacerbating the aforementioned problems (UNEP, 2006).

Since 1988 the extensive growth and spread of water hyacinth in the lake has also become a huge problem because of its myriad of effects, including: destruction of wetlands and waterways, prevention of fishing and recreational activities and for providing suitable habitats for disease vectors that cause bilharzia, encephalitis, and filariasis (LVEMP, 2003). Species diversity is also threatened in the Lake and some of this can be explained by the decline in water quality and quantity. Another key reason for the diminishing number of fish species is linked to the introduction of the Nile perch in the 1950's (Fuggle, 2002). Since then the perch has exploded in numbers causing serious predatory impacts on the lake's fish community. The dramatic expansion of the fishing industry coupled with this natural evolution in the last 25 years has proven devastating for the fish stock in the lake as a whole. Subsequently, the sustainability of the lake's fish stock is an increasingly important issue of concern, especially to those in the basin who rely on it as a source of income for their livelihood security but also to smallholder farmers who view fish as a cheap source of animal protein, compared to the more costly meat from livestock or chickens (UNEP, 2006).

The complexity and uncertainty of climate variability and change

Current climatic conditions in the LVB is very much linked to the water balance of Lake Victoria, which in turn is dominated by precipitation into the lake (82%) and evaporation out from the lake (76%), with minor contributions to the water inflow and outflow from rivers (UNEP, 2006). These local dynamics are further associated with interlinked, complex, and not yet fully understood climate drivers, including the movements of the Inter-tropical Convergence Zone, the large scale (African) monsoonal winds, the El-Nino Southern Oscillation phenomena (ENSO), the quasi-biennial oscillation, the meso-scale circulations and extra-tropical weather systems (Kizza et al 2009). A result of these climate dynamics is that rainfall variability in the basin is considerable, as seen also in my study region (Figure 5). This variability, both in terms of intensity but also in spatial reliability, not only determines local land-use potential but also has an influence on population distribution throughout the basin (Conway, 2009).

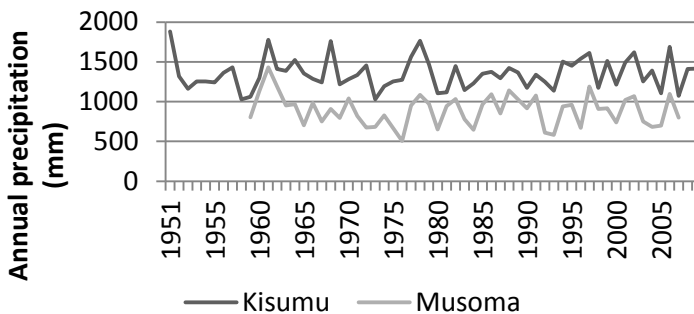


Figure 5. Annual rainfall from 1951/59 to 2007/2008 at Kisumu and Musoma meteorological station (Source: KMA and TMS, 2008).

Moreover, this rainfall variability makes the lake's hydrological cycle and hence freshwater system highly sensitive to changes in climatic conditions, especially rising temperatures, because of its effect on rainfall patterns (UNEP, 2006). But only a few historical climate studies have been conducted in the basin so far. These do however indicate a rise in average temperatures (from 0.5°C - 3.48°C) since the 1960s and a rise in the erraticness of rainfall over the last 100 years (Hecky et al., 1992; Wandinga, 2006; Kizza et al., 2009). Particularly noticeably is the increase in rainfall during the short rainy season between September and December (Kizza et al., 2009).

Still, much more locally specific climate research and analysis has to be conducted in different areas of the basin for this to be useful for local stakeholders and communities, considering the significant spatio-temporal variations that exist between locals and the potentially wide-ranging yet different outcomes for agriculture, hydrology, ecology and the economy in various local settings (Conway, 2002). And attributing these outcomes solely to climate variations may be problematic since other factors, such as, over-fishing, industrial pollution and sedimentation are also degrading the tributary water sources around Lake Victoria (Odada et al., 2004).

The complexity of the climatic patterns as such, and the patchiness of past climate studies, in combination with lack of sufficient local climate data, few sub-regional climate change scenarios using regional climate models or empirical downscaling, and the restricted computational facilities and scant availability of trained modelers in the LVB make future predictions for the region difficult to discern (Hudson and Jones, 2002; Swart et al., 2002; Jenkins et al., 2002). To date only a few attempts have been made to predict future climatic changes (Mwandosya et al., 1998; UNEP, 2006; Conway, 2009) and climate impacts on the LVB (Wandiga, 2006; Githeko, 2009; Thornton et al., 2010). Most other climate research focusing on future climate predictions covering East Africa (Hulme et al, 2001, Thornton et al., 2006; IPCC, 2007; Dinar et al., 2008) are large in scale, focusing on several countries in Africa, or the entire continent. In these studies East Africa is generally also treated as a homogenous climate region, despite the fact that there are tremendous differences in both rainfall variability and temperatures within the region, and even between my study sites, despite the short distances between them (Kizza et al., 2009). Still, while significant uncertainties remain about future climate changes in the LVB, common lessons from these large scale scenarios do support local study findings, which indicate a general increase in future temperatures and increased overall wetness, due to intensified erraticness of rainfall in particular (Mwandosya et al., 1998; Hulme et al, 2001, Thornton et al., 2006; UNEP, 2006; Wandiga; 2006; IPCC, 2007; Dinar et al., 2008; Githeko, 2009; Conway, 2009; Thornton et al., 2010).

The consequences of these complex changes on farmers' livelihoods, whether local or regional, are also difficult to predict. What is certain however is that they will likely affect agricultural production with subsequent impacts on a myriad other aspects of the already *multiplex livelihoods of smallholders* (Bryceson, 2002b). In addition to these broader ongoing socio-

economic and bio-physical processes it is also necessary to recognize the interlinkages between these processes of change and peoples day to day life. Of particular significance is the way peoples' cultural norms and practices may contribute to and maintain climate vulnerability.

People and livelihoods in the Lake Victoria basin

A multitude of indigenous ethnic groups inhabit the rural areas of the LVB, including; the Baganda, Basoga, Hutu, Kisii, Kalenjin, Kuria, Luhya, Luo, Maasai, Suba, Teso, Tutsi, Wahaya, Wajita, Wakara, Wakerewe, Wakurya, Waluo, Wamaasai, Waruri, Wasukuma, Wazanaki, Wazinja, Suba and Teso (UNEP, 2006). Although they are seemingly diverse ethnically, they still share similar livelihoods and socio-cultural norms due to the close linkages between natural resource management and cultural practices (Njogu et al., 2010).

Luo cultural norms and practices

In my main study sites most people belong to the Luo ethnic group. Luo culture is both patrilineal and patrilocal (Lee-Smith, 1997). Inheritance of property, i.e. land thus follows the male lineage and customary laws prohibit Luo women from owning land in their own right, instead Luo women can only apply their labor to their husband's or father's land. Moreover, upon marriage Luo women must relocate and live with the family of the husband and potentially his other wives, since polygyny is allowed, provided that the husband can afford it (Gunga, 2009; Lee-Smith, 1997). Consequently, virtually all power and wealth in a Luo community lies in the hands of men and this in turn delineates both *gendered rights and responsibilities* via the institution of marriage and the cultural practices of bride wealth and widow inheritance (Lee-Smith, 1997, Rocheleau et al., 1996).

For the recognition and legitimacy of a Luo marriage, husbands and families must exchange bride wealth for the reproductive and productive capabilities of the bride (Lee-Smith, 1997). In the Luo context bride wealth can thus be seen as an economic exchange between two *men*, one of whom (the father) is receiving compensation for the labor lost and the other (the husband to be) who pays bride price/wealth for the labor that the daughter/wife to be will produce. Although bride wealth does not give a man absolute rights over a woman, since he is not allowed to 'resell' her owing to specific obligations to her, it does entitle him to food and other items she produces (including children) (Miles, 2007). Women are expected to produce many children and

births should follow at regular intervals (Shipton 1989, Pala 1980). Sons in particular are expected, to symbolically carry on the male lineage and support their parents in old age (Gunga, 2009). The use of bride wealth in Luo society reflects both the lack of ownership *rights* that women have to their own production within marriage and the labor *responsibilities* she is expected to fulfil in order for the marriage contract to be met (Lee-Smith, 1997). It also demonstrates men's latent coercive powers over their wives, in terms of determining the extent of their autonomy today and in the future, as husbands' threat of divorce or taking on another wife compels women to comply with their demands (Lee-Smith, 1997).



Photos 8-10. Gendered responsibilities in Kunsugu – women grinding cassava and feeding chickens and a man tending to livestock. (Photos by: Sara Gabrielsson, 2007/2008/2009).

In Luo culture, as elsewhere in Sub-Saharan Africa gendered responsibilities are reflected through the differentiated amount, types and spheres of labor that women and men engaged in, where women are predominately bound to reproductive and productive activities within the domestic sphere, such as: caring for children, cooking, cleaning, washing, fetching water and fire wood, making charcoal, tending to the home garden and food crops as well as small livestock including chickens or goats. Men are viewed to be responsible for everything else: rearing cattle, tending to and selling cash crops, digging and clearing land as well as building and maintaining the house (Lee-Smith, 1997; Francis, 2000; Bryceson, 2002b; Rocheleau et al., 1996).

Gender differences are also observed in how men and women keep and use cash and their mobility and presence in public domains (Lee-Smith, 1997). Another demonstration of gendered rights within Luo society is the widespread practice of widow inheritance or *ter* in the Luo language, which

refers to a culturally sanctioned re-marriage (Gunga, 2009). Through widow inheritance, a male relative of the deceased husband takes over the guardianship of the deceased's family, including the wife, to make sure that the deceased's inherited property stays in the family (Ntozi 1997). However, in the Luo culture, the widow remains the wife of the deceased, although the guardian serves in the deceased husband's place, both physically and sexually. Hence, Luo widows are sometimes called 'widows of the grave' (Luke, 2002). In the past the custom of widow inheritance was used as a social welfare mechanism to ensure that women and children were always taken care of, even in the case of the death of the household head. Traditionally, the custom gave women the right to choose the male whose family she would now be a part of and the right to continue to maintain a separate household (Potash, 1986a). Then she had no domestic responsibilities toward the inheritor, but the inheritor could help the widow with ploughing, school fees or building a house (Potash, 1986b). In the past, as well as today, widows are expected and required to partake in a sexual cleansing ritual, whereby a professional cleanser, from outside the kinship, through sexual intercourse frees the widow from bondage before being re-incorporated into society (Ambasa-Shisanya, 2007). The threat and punishment of incurring cultural impurities for themselves and their children is the main reason why widows continue to participate in the ritual, despite the risk of attracting HIV that is so widespread in the region (Gunga, 2009).

Although the Kenyan constitution, under the Law of Succession Act, today actually assigns widows limited rights to their matrimonial homes the practice of widow inheritance is still widespread among Luo communities (Gunga, 2009). Ironically, despite an enacted judicial law that supposedly gives widows more rights in theory, in practice widowhood in recent years has become more challenging, resulting in higher health risks and heavier work and expenditure burdens (Luke, 2002). Out of fear of getting infected with HIV/AIDS many Luo men are today refusing to take on an inherited widow (Gunga, 2009). But this radical cultural change has not diminished the social pressures from tribal clansmen to continue the practice of widow inheritance and cleansing (Gunga, 2009). How these cultural norms may undermine or provide opportunities for increasing adaptive capacities is discussed in more detail in article 3.

Livelihoods in the LVB –still based on an economy of affection

Whatever indigenous ethnic group or clan people in the LVB belong to they still adhere to an economic livelihood system that is based on affection. This does not imply that everyone in that economic system is fond of each other. Rather it signifies an economic system built upon “a network of support, communications and interaction among structurally defined groups connected by blood, kin, community or other affinities” (Hydén, 1983: 8). According to Hydén (ibid) the functional purposes of the economy of affection among smallholders in SSA can be divided into three categories: (1) basic survival; (2) social maintenance; and (3) development.

Since so many smallholders in the LVB and elsewhere across rural Africa are marginalized from the market economy and generally lack access to credit institutions or welfare institutions smallholders’ must rely heavily on the exchange of services and assets between each-other to meet basic survival needs, such as food, cash, clothing or child-care. The necessity of these arrangements has thus made most African’s inclined to give priority to these informal arrangements rather than the formal kind due to the ‘trust and sense of mutual obligation’ (ibid: 11) that the face-to face exchange creates. Following this the economy of affection also provides the means to maintain social activities and rituals, such as loans to pay for weddings and burials. Moreover the economy of affection also plays a significant role for development, through for instance informal loan arrangements to develop small-scale businesses, expand farming practices or for constructing a house. It also involves calling upon family members and relatives to support the education of the less fortunate in an extended family either through payment of school fees or providing free accommodation (ibid: 14). The mutual obligation component of the economy of affection also supplies customers to community managed and run businesses and market places, who come from within their own structurally defined group (Njogu, 2010).

In sum the economy of affection provides vital services for smallholders in the absence of a welfare state. But there are also significant disadvantages with this system, the most critical being the imposed social obligations put on individuals that limit both their interest and their capacity to support public concern outside of their own community, which in turn can create both mistrust and conflict with others (Hydén, 1983: 17). A study such as this must take these livelihood processes into consideration when attempting to understand the adaptive capacities of smallholder farmers in the LVB.

5. Synthesis and contributions to current debates

“Find[ing] a middle ground between the overly simplistic, and the hopelessly complex”

(Fraser et al., 2003: 141)

The following is a synthesized discussion on the combined empirical findings from the three articles in this thesis and their implications for sustainable adaptation.

Having explored the smallholder farming system in the LVB using multiple methods, tools and techniques, my empirical data and analysis show that smallholder livelihoods are affected by climate variability and change in a number of ways and it is the *convergence in time and space* of these climate induced stressors that has the most critical effects on the smallholder farming system.

Three key processes have been identified as critical for this interaction:

1) The increased *unpredictability of rainfall* that may cause agricultural drought with palpable impacts on agricultural production and food prices as well as the spread of climate related vectors and pathogens leading to malaria, cholera, dengue fever and typhoid, to name a few.

2) The *growing reliance on cash* to ensure basic livelihood needs (e.g. food, fodder, water, fuel wood) due to shrinking revenues from agricultural production and price volatility.

3) The *amplified ‘costs’ of a recurring incidence of climate-associated diseases* that not only incur increased spending on health-care but also results in an increased work burden for women, loss of anticipated non-farm incomes and added costs of hiring agricultural labor when manpower is reduced or lost.

By using seasonal calendars as a heuristic the study has been able to illustrate how these stressors feed into and off each other thus amounting to different outcomes at different times of the year, depending on the type of stressors and the weight of their impact. Specifically, the calendars show that it is the destructive reinforcing feedbacks on the human-environment system, through continued illness, mismanaged crops, and ensuing food insecurity that creates the chronic livelihood stress faced by farmers in the LVB.

The study further reveals that the ability of smallholders to respond to the impacts caused by climate variability and change are restricted to four fundamental capacities. These are:

- 1) *Their own able-bodiedness* (Cleaver, 2005), which enables or disables individuals and households from engaging in farming and non-farming activities.
- 2) *Their access to a plot of arable land*, which enables or disables the production of sufficient amounts of food for home-consumption and sales.
- 3) *Their individual or collective purchasing power*, which enables or disables individuals and/or households to secure a buffer to ensure livelihood security.
- 4) *Their access to communities of practice* (Wenger, 1998), which enables or disables the pooling of time and labor as well as the sharing of resources and tools.

But the access to these adaptive capacities is constrained by two key socio-structural dependencies that delineate smallholder farmer's daily life and livelihoods. The first is the dependency on a *gendered regime* that assigns gender-differentiated rights and responsibilities (Mies, 1986; Rocheleau et al., 1996), which in turn structures how gender is performed and how the everyday life of smallholders is enacted. The second is the dependency on an *economy of affection* (Hydén, 1983), here defined primarily by ethnic belonging, whereby loyalty to your own ethnic kin is expected through imposed social obligations. These socio-structural dependencies not only undermine individual agency by limiting the choices of what people can or cannot do, where they may do it and with whom. It also restricts access to and ownership of critical resources and services (e.g. land, tools, livestock, financial institutions, farmer trainings, extension services, political appointments, specialized markets, collective actions groups etc.) that farmers need to increase their abilities to respond to climate variability and change. As a result some farmers have more capacity to adapt than others.

Figure 6, on the next page, demonstrates the multiple constraints to sustainable adaptation in the LVB. It illustrates the linkages between socio-structural processes and climate induced risks and how that complexity influences smallholders' access to fundamental adaptive capacities and livelihood strategies.

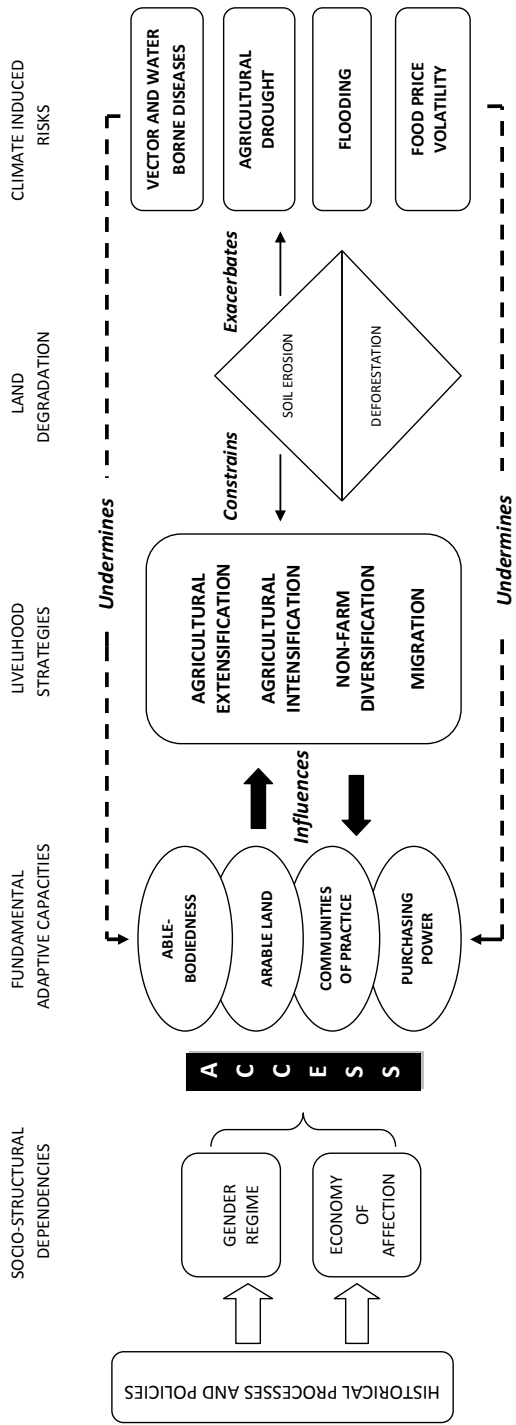


Figure 6. Constraints to sustainable adaptation in the LVB

Nevertheless, the study also reveals that if there is 'head room' (Tompkins and Adger, 2004) for farmers, and women in particular, to access resources, build agency and achieve their chosen outcomes they can and will adopt innovative livelihood strategies to respond to climate variability and change (See Article 2 and 3 especially). In my study context this 'head room' has oftentimes occurred after the death of a male farmer and the reluctance of male relatives to inherit a widow because of the risk of attracting HIV/AIDS, which has left the widow to fend for herself and she has responded by joining forces with others in the same or similar situation.

The difference between these, so far small number of farmers and others lies in the way they organize themselves and the proactive and planned strategies they employ compared to the reactive and autonomous coping mechanisms used by the great majority of other farmers in the study area to respond to increased unpredictability in rainfall. These deliberate strategies, rooted in a culture of saving and planning, are found among those, particularly women farmers, who in collective efforts based on trust and mutual engagement through the pooling of labor and sharing of risks, land plots and tools are able to increase food and income buffers by diversifying farm and non-farm incomes, experimenting with new crops and conserve natural resources. As such the strategies they employ are what Thomas and Twyman (2005) identify as critical 'regenerative' adaptation responses, because of their importance in attempting to address both dynamic and longer-term issues affecting their livelihoods today as well as in the future. So far however, groups of farmers' who have attempted this in the study areas are currently divided along gender and ethnic lines, consequently marginalizing some and excluding others from participating.

While the emergence of these new collective social institutions are still isolated islands of actions in my study areas, their rare existence, even among widows, indicates that adaptation to climate variability and change is possible provided that social change and gender empowerment is part of the process. Capitalizing on these findings is therefore a must in order to achieve the objectives of sustainable adaptation. But this will require a number of social transformations within smallholder communities across SSA. Among the more important ones are; 'the re-introduction of the African man into his family' (Maathai, 2009: 275) to balance work obligations and share the fruits of that labor within a household, as well as increase cooperation across

communities to break the social obligations imposed by the economy of affection and bridge the gaps between 'us and them' both in terms of ethnic loyalties and gender divisions.

In sum, these findings illustrates that current deficits in adaptation potential among the majority of smallholders in the LVB is an outcome of a combination of exogenous threats and endogenous adaptive capacities interlinked by local cultural norms and practices, regional socio-economic transformations and global unpredictabilities. A few of these interacting factors may be possible for smallholders themselves to influence while others are beyond their control and must be managed and shaped by stakeholders external to local communities such as regulating food prices etc. Yet, understandings of these inter-linkages are not always recognized in contemporary climate adaptation policies for Kenya and Tanzania and in much research and literature on climate adaptation with some exceptions: Kates, 2000; Thomas and Twyman, 2005; Tschakert, 2007; Eriksen and O'Brien, 2007; O'Brien et al., 2007; Adger et al., 2009; Ribot, 2009, Demetriades and Esplen, 2009; Wisner, 2010; Eriksen et al., 2011. This begs the question if there is a lack of political will and/or a gap in knowledge about these inter-linkages among policy makers and researchers. In any case, these are areas that need to be explored further in climate change and adaptation research.

The findings from this research demonstrate the value of using an integrative and place-based approach to understand climate vulnerability. Thus concurring with and responding to Morton's (2007) call for recognizing the complexity and high location-specificity of smallholders' production systems in order to understand the impact of climate change on smallholder agriculture. In addition, my identification of key climate-induced stressors and their temporal interactions within the human-environment system is congruent with Thompson and Scoones's (2009) plea for understanding interactions between climatic, agronomic and disease dynamics in rural areas of the global south. Moreover, my conclusion that smallholders in the LVB are facing a highly uncertain future with discernible, yet differentiated adaptation deficits, due to chronic livelihood stress driven by inequal access to fundamental adaptive capacities, echoes the notions made by Kates (2000), concerning the high social costs of adaptation paid by the global poor, thereby calling into question the goal of achieving sustainability through global inter-generational and intra-generational justice (Clark, 2009; Ziegler

and Ott, 2011). Given the widespread livelihood insecurity and the scale of adaptation deficits under climatic uncertainty, in the LVB, and elsewhere in rural SSA it is evident that it is here that governments, CBO's, NGO's and the international community must act since "learning by shock is neither an empowering nor an ethically defensible pathway" (Tschakert and Dietrich, 2010: 17) for future climate adaptation policy in the global south.

Guided by findings from this thesis, I argue that future sustainable adaptation policies targeting rural SSA need to be aware of *new signs* of chronic livelihood stress among smallholders, driven and characterized by recurrent and persistent agricultural drought rather than temporary climate extremes. Furthermore these policies must be informed by a contextualized understanding of how this livelihood stress is played out in situ across and within a community. Unless such knowledge exists suggested policies are likely to misread peoples' needs. These policies must also include a clear normative stance of what sustainable adaptation means and for whom in order to move away from reactive and autonomous coping towards anticipatory and planned strategies. These strategies must furthermore be built on knowledge that is accessible for those who need it most. This could be accomplished through carefully designed yet flexible, iterative learning-processes that are tailored to real day-to-day livelihood conditions, allow experimentation in practice, and offer tangible and short-term results as well as long-term benefits (Tschakert and Dietrich, 2010). Scaling up sustainable adaptation across countless communities in SSA will thus require time and resources from both local stakeholders and external facilitators. For these reasons, and given the increasing complexity and heterogeneous nature of rural smallholder livelihoods, I suggest that future sustainable adaptation interventions avoid rigid sampling based on extreme climate scenarios and instead target and build upon those existing groups or activities that are self-selecting in terms of smallholders' interest and time availability.

Ultimately what this thesis shows is that there are farmers who despite insidious livelihood conditions and circumstances, through increased agency and ownership have built the confidence and capacity needed to become agents of change and owners of a future shaped by both social justice and environmental integrity. As a sustainability scientist it is part of my commitment to spread these 'best practices' so that others also can find hope and learn from them.

6. A concluding remark on Sustainability Science

After reviewing articles published in *PNAS Sustainability Science* in the period 2003-2010, Kates (2011) contends that there is a clear bias in Sustainability Science (SS) towards environmental science although the expressed goal of SS is to study how life support systems can ensure human and social needs. He concludes that the varied fields of ‘development sciences’, including health and human development, economic and social development, governance, and the multitude of technologies that enable development are still underrepresented in the journal. Moreover, his analysis highlights that while SS emphasizes stakeholder involvement and collaboration with practitioners from local communities, industry, government and civil society there has, to date, been little progress on actual co-produced solutions. This is unfortunate given the emphasis in SS on problem based research. A regional and place-based study like this thesis, emphasizing the actual context and highlighting the importance of including local stakeholders into the research process, is an attempt to contribute to filling this gap in SS.

As stated in the introductory chapter, this research process has been shaped by my struggles to bridge the gap between the natural and social sciences. Standing in my way has oftentimes been my own scholarly bias in the social and environmental sciences but perhaps more significantly the perceived tilt and reviewer bias in SS towards the natural sciences. A lesson learned here relates to crossing the social and natural science divide in *practice*: how to engage in interdisciplinary research by collaborating with people from other disciplines despite differences in scientific language and the understanding of *ways to do* research and *write about* research? At the start of my PhD project these divides hampered my ability to move forward because of a (too) wide range of theories, methods and techniques that I did not master. At the end of the journey these uncharted waters have taught me the value of being a generalist rather than a specialist. A turning point appeared when I had the opportunity to do fieldwork in my study sites together with a colleague trained in physical geography and sustainability science. From this experience I learned that it is not necessary at the outset to know all matters and methods in detail – as long as one can collaborate with, listen to and learn from others who have other competencies in and experiences from the field. I am therefore ready and excited to play a part in furthering sustainability science in the future.

References

- Adger, W. N., (2003) 'Social capital, collective action, and adaptation to climate change' *Economic geography* 79(4): 387-404.
- Adger, N. and K. Vincent (2005) 'Uncertainty in adaptive capacity' in *Geoscience*, 337, 399-410.
- Adger, W.N. (2006) 'Vulnerability' *Global Environmental Change*, 16 (3), 268–281.
- Adger, W.N., Dessai, S., Goulden, M., Hulme, M., Lorenzoni, I., Nelson, D.R., Naess, L-O., Wolf, J., and A. Wreford (2009) 'Are there social limits to adaptation to climate change?' in *Climatic Change*, 93: 335–354.
- Ambasa-Shisanya, C.R. (2007) 'Widowhood in the era of HIV/AIDS: A case study of Siaya District, Kenya' in *Journal of Social Aspects of HIV/AIDS*, Vol. 4 no.2.
- Barnett, J. and S. O'Neill (2010) 'Maladaptation' in *Global Environmental Change*, 20, 211–213.
- Bebbington, A. (1999) 'Capitals and capabilities: A framework for analyzing peasant viability, rural livelihoods and poverty' *World Development* 27(12): 2021-2044.
- Blaikie P., Cannon, T., Davis, I., Wisner, B. (1994) *At Risk: Natural Hazards, People's Vulnerability, and Disaster*. Routledge, London.
- Brooks, N. (2003) 'Vulnerability, risk and adaptation: A conceptual framework', Tyndall Centre Working Paper 38, Tyndall Centre for Climate Change Research, Norwich, UK.
- Brown, K (2011) 'Sustainable adaptation: An oxymoron?' in *Climate and Development*, 3, 21–31.
- Bryceson, D (2002a) 'The scramble in Africa: reorienting rural livelihoods' in *World Development*, 30, 725-739.
- Bryceson, D. (2002b) 'Multiplex livelihoods in rural Africa: recasting the terms and conditions of gainful employment' in *The Journal of Modern African Studies*, Vol. 40. No. 1., 1-28.
- Bryceson, D. F., and J. Fonseca (2006) 'Risking death for survival: Peasant responses to hunger and HIV/AIDS in Malawi' in *World Development* 34 (9)
- Bryman, A. (2008) *Social research methods*, Oxford: Oxford University Press.
- Campbell, L. (2000) *Investigation of the source of mercury in Lake Victoria, its cycles between air, water, lake sediments and aquatic life*. Ph.D. Thesis, Department of Biology, University of Waterloo, Ontario, Canada.
- Caplan, G. (2008) *The Betrayal of Africa*, Greenwood Books, House of Ananasi Press: Toronto.
- Chambers, R. (2008) *Revolutions in development inquiry*. London: Earthscan.
- Charmaz, K. (2006) *Constructing Grounded Theory: A Practical Guide Through Qualitative Analysis*. Thousand Oaks, CA: Sage Publications.
- Clark, W. and Dickson, N. (2003) 'Sustainability science: the emerging research program' *PNAS* 100 (14):8059–8061.
- Clark, W. C. (2007) 'Sustainability science: A room of its own' in *PNAS* 104(6): 1737.

- Clark, W.C. (2009 'Nurturing sustainability' in *Issues in Science & Technology*, vol. 26, No. 1: 9-10.
- Clark, W.C. and S.A. Levin (2010) 'Toward a Science of Sustainability: Report' Toward a Science of Sustainability Conference, Nov 29th- Dec 2nd, 2009. Warrenton, Virginia.
- Cleaver, F. (2005) 'The inequality of social capital and reproduction of chronic poverty' in *World Development*, Vol. 33(6): 893-906.
- Conway, D. (2002) 'Extreme rainfall events and lake level changes in East Africa: recent events and historical precedents' in *The East African great lakes: limnology, palaeolimnology and biodiversity*, Eds., E. O. Odada and D.O. Olago, pp. 63–92. Advances in Global Change Research, vol. 12. Dordrecht: Kluwer.
- Conway, D., A. Persechino, S. Ardoin-Bardin, H. Hamandawana, C. Dieulin, G. Mahé (2009) 'Rainfall and water resources variability in sub-Saharan Africa during the twentieth century' in *Journal of Hydrometeorology*, 10, 41–59.
- Corbett, J. (1988) 'Famine and household coping strategies' in *World Development*, 16 (9), 1099–1112.
- Crenshaw, R. (1989) *Demarginalizing the intersection of race and sex: a black feminist critique of antidiscrimination doctrine, feminist theory, and antiracist politics*, University of Chicago Legal Forum, 139.
- Curtis, P. (1995) 'Urban household coping strategies during war: Bosnia Hercegovina' in *Disasters*, 19(1):68-73.
- Demetriades, J and Esplen, E., (2009) 'The Gender Dimensions of Poverty and Climate Change' in *The Social Dimensions of Climate Change: Equity and Vulnerability in a Warming World*, New Frontiers of Social Policy, World Bank.
- Desai V. and R. B. Potter eds. (2006) *Doing Development Research*, London, Thousand Oaks, California and New Delhi: Sage Publications Ltd.
- Deveraux, S. (1993) 'Goats before ploughs: dilemmas of household response sequencing during food shortages' in *IDS Bulletin*, 24(4):52-59.
- De Waal, A. (1989) *Famine That Kills*, Oxford: Clarendon Press.
- Dinar, A., R. Hassan, R. Mendelsohn, and J. Benhin (eds) (2008) *Climate Change and Agriculture in Africa: Impact Assessment and Adaptation Strategies*, London: Earthscan.
- Dreze, J. and A. Sen (1991) *Hunger and public action* Oxford University Press: UK
- Dubell, F. (1994) *Kenya- Från enpartistat till demokrati?* Nordiska Afrika Institutet: Uppsala.
- Ellis, F. (1998) 'Household strategies and rural livelihood diversification' in *Journal of Development Studies*, 35(1) 1–38.
- Ellis, F. (2000) *Rural Livelihoods and Diversity in Developing Countries*. Oxford, UK.
- Eriksen, S. H., K. Brown and P.M., Kelly. (2005) 'The dynamics of vulnerability: locating coping strategies in Kenya and Tanzania' in *The Geographical Journal*, 171(4): 287-305.

- Eriksen, S. and K. O'Brien. (2007) 'Vulnerability, poverty and the need for sustainable adaptation measures' in *Climate Policy*, 7. 337–352.
- Eriksen, S., Aldunce, P., Bahinipati, C. S., Martins, R. D'A., Molefe, J. I., Nhemachena, C., O'Brien, K., Olorunfemi, F., Park, J., Sygna, L. and Ulstrud, K. (2011) 'When not every response to climate change is a good one: identifying principles for sustainable adaptation' in *Climate and Development*, 3(1): 7–20.
- Flick, U. (2006) *An introduction to qualitative research*. London: Sage Publications Ltd.
- Francis, E. (1998) 'Gender and rural livelihoods in Kenya' in *Journal of Development Studies*, 35(2) 72–95.
- Francis, E. (2000) *Making a living. Changing livelihoods in rural Africa*. Routledge
- Frankhauser, S., Smith, J.B., Tol, R.S.J. (1999) 'Weathering climate change: some simple rules to guide adaptation decisions' in *Ecological Economics* 30, 67–78.
- Fraser, E.D.G., Mabee, W. and O. Slaymaker (2003) 'Mutual vulnerability, mutual dependence: The reflexive relation between human society and the environment' in *Global Environmental Change*, 13 (2003) 137–144.
- Fuggle, R.F. (2002) 'Lake Victoria: a case study of complex interrelationships', UNEP, 2002.
- Füssel, H. M. and R. J. T. Klein (2006) 'Climate change vulnerability assessments: an evolution of conceptual thinking' *Climatic Change* 75(3): 301-329.
- Futuyama, D.J., 1979. *Evolutionary Biology*. Sinauer, Sunderland.
- Giddens, A. (1979) *Central Problems in Social Theory: Action Structure and Contradiction in Social Analysis*. Macmillan, London.
- Gillespie, S. ed. (2006) *AIDS, poverty, and hunger: Challenges and responses.*, Highlights of the International Conference on HIV/AIDS and Food and Nutrition Security, Durban, South Africa, April 14–16, 2005. Washington, DC: International Food Policy Research Institute, 375 pp.
- Githeko, A. K. (2009) *Malaria and climate change*, Commonwealth Health Ministers' Update, Nairobi: Kenya.
- Green, M. and Hulme D. (2005) 'From Correlates and Characteristics to Causes: Thinking About Poverty from a Chronic Poverty Perspective' in *World Development*, 33(6), 867-879.
- Grothmann, T. and A. Patt (2005) 'Adaptive capacity and human cognition: the process of individual adaptation to climate change' in *Global Environmental Change*, 15, 199-213.
- Guba, E. G., & Lincoln, Y. S. (1989) *Fourth generation evaluation*. Newbury Park, CA: Sage
- Gunga, S. (2009) 'The politics of Widowhood and Re-Marriage among the Luo of Kenya' *Thought and Practice: A Journal of the Philosophical Association of Kenya*, Vol.1 No.1, June 2009, 161-174.
- Habermas, J. (1971) *Knowledge and human interests*. Boston: Beacon Press.

- Hecky, R. E. and F. W. B. Bugenyi (1992) 'Hydrology and Chemistry of the African Great Lakes and Water Quality issues: Problems and Solutions' *Mitt. Int. Ver. Theoretical. Angew. Limnology*, 23:45–54.
- Hinkel, J. (2011) 'Indicators of vulnerability and adaptive capacity: Towards a clarification of the science-policy interface' *Global Environmental Outlook*, Volume 21, Issue 1, February 2011, 198-208.
- Hudson, D.A. and R.G. Jones (2002) 'Regional climate model simulations of present day and future climates of Southern Africa' Technical Note 39, Hadley Centre, Bracknell, 42 pp.
- Hulme, M., Doherty, R., Ngara, T., New, M., and Lister, D. (2001) 'African Climate Change: 1900-2100' in *Climate Research* 17, 145-168.
- Huq, S., Rahman, A., Konate, M., Sokona, Y., Reid, H., (2003) *Mainstreaming Adaptation to Climate Change in Least Developed Countries* (LDCS) International Institute for Environment and Development, London.
- Hydén, G. (1983) *No shortcuts to progress: African development management in perspective*, Berkeley: University of California Press.
- Ikeme, J. (2003) 'Equity, environmental justice and sustainability: incomplete approaches in climate change politics' in *Global Environmental Change* 13(3), 195-206.
- International Lake Environment Committee (2005) 'Managing Lakes and Their Basins for Sustainable Use - A Report for Lake Basin Managers and Stakeholders', ILEC, Kusatsu.
- IPCC (2001) *Climate Change 2001: Impacts, Adaptation and Vulnerability*, Summary for Policymakers and Technical Summary of the Working Group II Report. McCarthy, J.J., Canziani, O.F. Leary, N.A., Dokken D. J. and White, K. S., eds. IPCC: Geneva.
- IPCC (2007) *Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Parry, M.L., O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson eds., Cambridge, UK: Cambridge University Press.
- Jambiya, G. (1998) *The dynamics of population, land scarcity, agriculture and nonagricultural activities: West Usambara Mountains, Lushoto District, Tanzania*. Working Paper, Vol. 28. Dar es Salaam: Institute of Resource Assessment and Leiden: African Studies Center.
- Jenkins, G.S., G. Adamou and S. Fongang (2002) 'The challenges of modelling climate variability and change in West Africa' in *Climatic Change*, 52, 263-286.
- Kabeer, N. (1999) 'Resources, Agency, Achievements: Reflections on the Measurement of Women's Empowerment' in *Development and Change* Vol. 30, No. 3, 435–64.
- Kasperson, J.X., Kasperson, R.E., (2001) *Global Environmental Risk*, United Nations University Press, Tokyo.

- Kates, R.W. (2000) 'Cautionary tales: adaptation and the global poor' in *Climatic Change* 45, 5–17.
- Kates, R., Clark, W., Corell, R., Hall, J., Jaeger, C., Lowe, I., McCarthy, J., Schellnhuber, H., Bolin, B., Dickson, N., Faucheux, S., Gallopin, G., Grubler, A., Huntley, B., Jager, J., Jodha, N., Kasperson, R., Mabogunje, A., Matson, P., Mooney, H., Moore III, B., O'Riordan, T., & Svedlin, U. (2001) 'Sustainability science' *Science* 292(5517): 641–642.
- Kates, R.W. (2011) 'From the Unity of Nature to Sustainability Science: Ideas and Practice' CID Working Paper No. 218. Center for International Development, Harvard University. Cambridge, MA: Harvard University.
- Kizza, M., A. Rodhe, et al. (2009) 'Temporal rainfall variability in the Lake Victoria Basin in East Africa during the twentieth century' in *Theoretical and Applied Climatology*, 98(1), 119-135.
- Klein, R.J.T., Nicholls, R.J. and Mimura, N. (1999) 'Coastal adaptation to climate change: can the IPCC Technical Guidelines be applied?' in *Mitigation and Adaptation Strategies for Global Change* 4, 239–252.
- Komiyama, K. & Takeuchi, K. (2006) 'Sustainability science: building a new discipline' *Sustainability Science* 1(1):1–6.
- Lal, P. (2010) 'Militants, mothers and the natural family: Ujaama, gender and rural development in post-colonial Tanzania' in *Journal of African History*, 51: 1-20.
- Lee-Smith, D. (1997) *My house is my husband*, PhD Thesis, Lund Institute of Technology, Division of Architecture and Development Studies. Lund University: Sweden.
- Luke, N. (2002) 'Widows and "Professional Inheritors": Understanding AIDS Risk Perceptions in Kenya'. Paper presented at the Population Association of America Annual Meetings, May 8-11, Atlanta, GA.
- LVEMP (2003) *Lake Victoria Environmental Management Project Phase 1*, Draft, Kenya Stocktaking Report, Washington DC: World Bank.
- Maathai, W. (2009) *The Challenge for Africa – A New Vision*, William Heinemann: London.
- Madulu, N.F. (1998) *Changing lifestyles in farming societies of Sukumaland: Kwimba District, Tanzania*. Working Paper, Vol. 27. Dar es Salaam: Institute of Resource Assessment and Leiden: African Studies Center.
- Mies, M. (1986) *Patriarchy and Accumulation on a World Scale – Women in the International Division of Labor*, London: Zed Books Ltd.
- Mikkelsen, B. (2005). *Methods for development work and research: a guide for practitioners*, India: Sage Publications.
- Miles, C. (2007) "'Because women are property": Issues of Gender, Food Security, Property Ownership, Quasi-Development and Religion in Sub-Saharan Africa' UNU-WIDER Conference on Gender and Food Security, May 2007, Accra, Ghana
- MLWE (2002) *Initial National Communication on Climate Change*, Ministry of Lands, Water and Environment Uganda.

- Morton, J. F. (2007) 'The impact of climate change on smallholder and subsistence agriculture' in *PNAS* 104, 50, 19680-85.
- Mwandosya, M.J., Nyezi, B., Luhanga, M.L., 1998. *The assessment of vulnerability and adaptation to climate change impacts in Tanzania*. CEEST, Dar es Salaam, Tanzania.
- Njogu, K., Ngeta. K. and M. Wanjau, eds. (2010) *Ethnic Diversity in Eastern Africa – Opportunities and Challenges*, Twaweza Communications: Nairobi, Kenya.
- Ntozi, J.P.M. (1997) 'Widowhood, remarriage and migration during the HIV/AIDS epidemic in Uganda' in *Health Transition Review*, Supplement to Volume 7: 125-144.
- O'Brien, K., Eriksen, S., Nygaard, L. P. and Schjolden, A. (2007) 'Why different interpretations of vulnerability matter in climate change discourses' in *Climate policy* 7(1): 73-88.
- O'Brien, K. and Leichenko, R. (2007) *Human Security, Vulnerability and Sustainable Adaptation*. Human Development Report Office, Occasional Paper 2007/9. UNDP, New York.
- Odada, E.O., Olago, D.O., Kulindwa, K., Ntiba, M., and Shem Wandiga (2004) 'Mitigation of Environmental Problems in Lake Victoria, East Africa: Causal Chain and Policy Option Analysis' in *Ambio*, Vol. 22 No. 1-2.
- Odada, E. O., W. O. Ochola (2009) 'Drivers of ecosystem change and their impacts on human well-being in Lake Victoria basin' in *African Journal of Ecology*, 47: 46-54.
- Okin, S. (2003) 'Poverty, Well-Being, and Gender: What Counts, Who's Heard?' in *Philosophy and Public Affairs*, 31(3), 280-316.
- Olago, D., M. Marshall, et al. (2007) 'Climatic, socio-economic, and health factors affecting human vulnerability to cholera in the Lake Victoria basin, East Africa' in *Ambio* 36(4): 350-358.
- Olsson, L., Jerneck, A. (2010) 'Farmers fighting climate change – from victims to agents in subsistence livelihoods' in *Wiley Interdisciplinary Review on Climate Change*, Vol 1, May/June 2010: 362-373.
- Osbahr, H. (2007) *Building resilience: adaptation mechanisms and mainstreaming for the poor. Fighting climate change: human solidarity in a divided world*. Background paper for UNDP Human Development Report 2007/2008, New York, New York, USA.
- Pala, A.O. (1980) 'Daughters of the lakes and rivers: Colonization and the land rights of Luo women' in M. Etienne and E. Leacock, eds. *Women and colonization*. New York: Praeger.
- Patton, M.Q. (1990) *Qualitative evaluation and research methods*, Newbury Park, CA: SAGE.
- Pielke, R.A.J. (1998) 'Rethinking the role of adaptation in climate policy' in *Global Environmental Change* 8, 159–170.
- Potash, B. Ed. (1986a) *Widows in African Societies*, Stanford: Stanford University Press.

- Potash, B. (1986b) 'Wives of the Grave: Widows in a Rural Luo Community' in Potash, Betty ed. Stanford: Stanford University Press, pp.44-65.
- Preston, B., E. Yuen, and M. Westaway (2011) 'Putting vulnerability to climate change on the map: a review of approaches, benefits, and risks', *Sustainability Science* 6(2): 177-202.
- Rahmato, D (1991) *Famine and survival strategies*, Uppsala: Scandinavian Institute of African Studies.
- Reid, P. and C. Vogel (2006) 'Living and responding to multiple stressors in South Africa: glimpses from KwaZulu Natal' in *Global Environmental Change*, 16, 195-206.
- Ribot, J.C., Magalhaes, A. and Panagides, S. eds. (1996) *Climate Variability, Climate Change, and Social Vulnerability in the Semi-Arid Tropics*, Cambridge, Cambridge University Press.
- Ribot, J. (2009) 'Vulnerability does just not fall from the sky: toward multi-scale pro-poor climate policy' in R. Mearns and A Norton eds., *Social Dimensions of Climate Change: Equity and Vulnerability in a warming world*. Washington, DC: The World Bank.
- Rocheleau, D., Thomas-Slayter, B., and Esther Wangari, Eds. (1996) *Feminist Political Ecology: Global issues and Local experiences*. Routledge, London
- Rodney, W. (1973) *How Europe underdeveloped Africa*, Bogle-L'Ouverture Publications, London and Tanzania Publishing House, Dar-Es-Salaam.
- Rugalema, G (2000) 'Coping or struggling? – A Journey into the Impact of HIV/AIDS in Southern Africa' in *Review of African Political Economy*, No. 86: 537-545.
- Schröter, D., C. Polsky and A. Patt (2005) 'Assessing vulnerabilities to the effects of global change: an eight step approach' in *Mitigation and Adaptation Strategies for Global Change* 10(4): 573-595.
- Scoones, I. (1998) *Sustainable rural livelihoods: a framework for analysis*, IDS, Brighton:
- Sen, A. (1981) *Poverty and Famines: An Essay on Entitlement and Deprivation*, Oxford University Press: UK.
- Sen, A. (1999) *Commodities and capabilities*, Oxford University Press: UK.
- Shepherd, K., Walsh, M., Mugo, F., Ong, C., Hansen, T.S., Swallow, B., Awiti, A., Hai, M., Nyantika, D., Ombao, D., Grunder, M., Mbote, F., Mungai, D. (2000) *Improved land management in the Lake Victoria basin: Linking land and lake, research and extension, catchment and lake basin*, ICRAF and Kenya Ministry of Agriculture and Rural Development, Soil and Water Conservation Branch, National Soil and Water Conservation Programme, Nairobi, Kenya.
- Shipton, P. (1989) *Bitter money: Cultural economy and some African meanings of forbidden commodities*. American Ethnological Society Monograph Series, No. 1.
- Smit, B., Burton, I., Klein, R., Wandel, J. (2000) 'An anatomy of adaptation to climate change and variability' in *Climatic Change* 45, 223–251

- Smit, B., Pilifosova, O., (2003) 'From adaptation to adaptive capacity and vulnerability reduction' *Climate Change, Adaptive Capacity and Development*, Smith, J.B., Klein, R.J.T., Huq, S. Eds., Imperial College Press, London.
- Smit, B., Wandel, J. (2006) 'Adaptive capacity, adaptation and vulnerability' in *Global Environmental Change*, 16: 282–292.
- Smithers, J., Smit, B. (1997) 'Human adaptation to climatic variability and change' in *Global Environmental Change*, 7: 129–146.
- Swallow, B., Walsh, M., Nyantika, D., Muriithi, S., Noordin, Q., Ong, C., Shepherd, K., Place, F., Awiti, A., Hai, M., Ochieng, O., Cohen, M., Mugo, F., Oyasi, S., Omuto, C., Cohen, L., Okono, A. (2002) *Improved land management in the Lake Victoria basin. Annual Technical Report July 2001 to June 2002*, Working Paper 2002-2., ICRAF and National Agricultural and Livestock Extension Programme of the Kenya Ministry of Agriculture and Rural Development, Nairobi, Kenya.
- Swallow, B. M., et al. (2009) 'Tradeoffs, synergies and traps among ecosystem services in the Lake Victoria basin of East Africa' *Environmental Science & Policy* 12(4): 504-519.
- Swart, R., J. Mitchell, T. Morita and S. Raper (2002) 'Stabilisation scenarios for climate impacts assessment' in *Global Environmental Change*, 12, 155-165.
- Swidler, A. (1986) 'Culture in action: symbols and strategies' in *American sociological review*, 51 (2), 273–286.
- Thomas, T.S.G. and Twyman, C. (2005) Equity and justice in climate change adaptation amongst natural-resource-dependent societies, *Global Environmental Change* 15, 115–124.
- Thompson, J. and I. Scoones (2009) 'Addressing the dynamics of agri-food systems: an emerging agenda for social science research', *Environmental Science & Policy* 12 (4).
- Thornton PK, Jones PG, Owiyo T, Kruska RL, Herrero M, Kristjanson P, Notenbaert A, Bekele N and Omolo A, with contributions from Orindi V, Otiende B, Ochieng A, Bhadwal S, Anantram K, Nair S, Kumar V and Kulkar U (2006). *Mapping climate vulnerability and poverty in Africa*. Report to the Department for International Development, ILRI, Kenya. pp 171.
- Thornton, P. K., Jones, P.G., Alagarswamy, G., Andresen, J. and Herrero, M (2010) Adapting to climate change: Agricultural system and household impacts in East Africa. *Agricultural Systems* 103, 73-82.
- Tompkins, E. L. and W. N. Adger (2004) "Does adaptive management of natural resources enhance resilience to climate change?" in *Ecology and Society* Vol. 9. No. 2
- Tschakert, P. (2007) "Views from the vulnerable: understanding climatic and other stressors in the Sahel" in *Global Environmental Change* 7: 381–396.
- Tschakert, P. and K.A. Dietrich (2010) 'Anticipatory learning for climate change adaptation and resilience' in *Ecology and Society*, 15(2).

- Turner B L, Kasperson R E, Matson P A, McCarthy J J, Corell R W, Christensen L, Eckley N, Kasperson J X, Luers A, Martello M L, Polsky C, Pulsipher A and Schiller A. (2003) 'A framework for vulnerability analysis in sustainability science', *PNAS* 100 8074–9.
- Tyson, P., Odada, E., Schulze, R. and Vogel, C. (2002) "Regional-global change linkages: Southern Africa" in *Global-Regional Linkages in the Earth System*, eds. P. Tyson, R. Fuchs, C. Fu, L. Lebel, A.P. Mitra, E. Odada, J. Perry, W. Steffen and H. Virji, Springer Verlag, Berlin.
- Ulsrud, K., Sygna, L. and O'Brien, K. L. (2008) *More than Rain: Identifying Sustainable Pathways for Climate Adaptation and Poverty Reduction*. Report prepared for the Development Fund, Norway.
- UNEP (2006) *Environment for development: an ecosystems assessment of Lake Victoria basin environmental and socio-economic status, trends and human vulnerabilities*. Odada, E., Olago, D. and W Ochola eds., Nairobi: Kenya.
- URT (2003) *Initial National Communication Under the United Nations Framework Convention on Climate Change (UNFCCC)*. Office of the Vice President, Tanzania.
- Vogel, C. (2000) 'Usable Science: An assessment of long-term seasonal forecasts amongst farmers in rural areas of South Africa' in *South African Geographical Journal*, Volume 82, Issue 2: 107-116.
- Wandiga S. Ed. (2006) 'Climate Change Induced Vulnerability to Malaria and Cholera in the Lake Victoria Region - A Final Report' Assessments of Impacts and Adaptations to Climate Change Project, International START Secretariat, Washington, DC: USA.
- Watts, M. (1983) *Silent Violence: Food, Famine and Peasantry in Northern Nigeria*, Berkley: University of California Press.
- Watts, M. J. and H. G. Bohle (1993) 'The space of vulnerability: the causal structure of hunger and famine' in *Progress in human geography* 17(1): 43-67.
- Wenger, E (1998) *Communities of Practice*, Cambridge: Cambridge University Press.
- Wilbanks, T., Kates, R.W., (1999), "Global change in local places: how scale matters" *Climatic Change* 43, 601–628.
- Wisner, B. (2010) *Climate change and cultural diversity*, UNESCO, Oxford: Blackwell Publishing.
- Yohe, G. and R. Tol (2002) 'Indicators for social and economic coping capacity-moving toward a working definition of adaptive capacity' in *Global Environmental Change*, 12, 25–40.
- Ziegler, R and K. Ott (2011) 'The quality of sustainability science: a philosophical perspective', *Sustainability: Science, Practice and Policy*, Vol. 7, No. 1. pp. 31-44.



Living without buffers

Illustrating climate vulnerability in the Lake Victoria basin

SARA GABRIELSSON*, SARA BROGAARD AND ANNE JERNECK

Centre for Sustainability Studies, Lund University (LUCSUS) PO Box 170, 221 00 Lund, Sweden

Abstract

Exposure, sensitivity and adaptive capacity are essential, yet theoretically vague, components of climate vulnerability. That has triggered a debate on how they can be translated into and understood in an empirical context subject to present and future harm. In this article, which draws on extensive fieldwork in two countries in the Lake Victoria Basin (LVB), we illustrate one and each of the vulnerability components and discuss how they interact in situ. Using a mixed methods approach including survey data, rainfall data and a suite of participatory methods, such as focus groups and interactive mapping of seasonal calendars, we identify how climate induced stressors affect smallholder farmers' well-being and natural resources. Drawing on the seasonal calendar as a heuristic and the climate vulnerability terminology, we illustrate *when*, *where* and *how* these climate induced stressors converge to constrain farmers' livelihoods. Our analysis indicate that farmers in the basin are facing a highly uncertain future with discernible, but differentiated, adaptation deficits due to recurring, and potentially worsening, patterns of hardship.

Keywords: climate vulnerability, exposure, sensitivity, differential adaptive capacity, smallholder farmers, Lake Victoria Basin

*Corresponding author:

Sara Gabrielsson, Lund University (LUCSUS)

Sara.Gabrielsson@lucsus.lu.se

Introduction

The realization that climate change is posing tangible threats to the sustainability of planet earth has given rise to new scientific inquiries, such as the emerging research field of sustainability science (SS). It aims to understand the conditions of human-environment interactions and find ways to meet the needs of society while at the same time ensuring that the planet's life support systems are sustained (Turner et al., 2003; Clark, 2007). Conceptualizing vulnerability is a central element within both SS and the climate change discourse owing to the significance of defining crucial questions like: who and what is vulnerable to certain climate stressors, where may these be located, how may various societal or natural conditions amplify this vulnerability, and what can be done to respond and reduce those vulnerabilities.

The appeal for vulnerability as a concept lies in its inclusive nature, whereby humans and the natural environment are seen as intimately coupled and differentially exposed, differentially sensitive and differentially adaptable to threats (Polsky, et al, 2007). Studying this is difficult perhaps arguably impossible because it demands a thorough investigation of every biophysical, social, cultural and cognitive aspect of human-environment interactions (ibid). Accordingly, research focusing on coupled human-environment systems necessitates the theoretical expertise and methods from several research fields, such as risk and disaster management, political ecology, sustainable livelihoods frameworks and resilience research (Ingram et al., 2010). This realization has resulted in many frameworks that attempt to understand vulnerability (Wisner and Luce, 1993; Watts and Bohle, 1993; Ribot et al, 1996; Kasperson and Kasperson, 2001; Brooks, 2003; Cutter et al., 2003; Turner et al., 2003; Schröter et al., 2005; Adger 2006; Fussel and Klein, 2006; Polsky et al., 2007, Scoones and Thompson, 2009; Ionescu et al., 2009; Hinkel, 2011; Preston et al., 2011) despite the fact that vulnerability itself cannot be observed nor measured directly, but rather must be deduced (Hinkel 2011).

Some scholars (Patt et al., 2009), argue that these theoretical developments have lured scientists into a trap of simplifying the complexity and uncertainty of a specific vulnerability system to such an extent that it may no longer be helpful for our overall understanding of what vulnerability entails.

Because of this 'epistemological trap' there is a need for in-depth, place-based assessments, especially in places like the Lake Victoria Basin (LVB) in East Africa, where imminent vulnerabilities are present (Fuggle, 2002; UNEP, 2006; Olago et al., 2007; Odada et al., 2009) and where such integrative investigations are missing. But there may be many constraints to perform such an inclusive vulnerability assessment and to do so across a vast number of communities, including time, funds, knowledge and participation of affected stakeholders. Consequently, this calls for a more

generalizable and easily transferable methodology for vulnerability assessments that can be applied in settings where such constraints are high, including the LVB.

Inspired by Schröter et al. (2005), we construct and apply a modified version of their assessment approach for analysing the climate vulnerability of smallholder farmer livelihoods in the LVB. Our objective is to empirically analyze the convergence of climate induced stressors and how such dynamics turn into recurring periods of hardship detrimental to local communities in terms of food security and well-being. Drawing on a range of mainly qualitative data and following a multi-scalar strategy that combines village data with regional district level data as recommended by other scholars (See Morton, 2007; Preston et al 2011) we assess ‘the factors that determine the potential for harm from exogenous threats as well as the endogenous adaptive capacity’ (Preston et al., 2011: 183). To that end we have tried to downscale global climate change into a local context where it is experienced and from that position we map the local vulnerability through participatory processes. By emphasizing the *temporal* aspects of climate vulnerability and by examining the *differential adaptive capacities* that people have to buffer themselves against such vulnerabilities, we show the importance of place-based vulnerability mapping and analysis for informing viable climate adaptation and development policies.

Conceptualizing climate vulnerability

Vulnerability is a compound of three partly overlapping elements: exposure, sensitivity and adaptive capacity (See fig.1) (McCarthy et al., 2001; Yohe and Tol, 2002; Adger, 2003; Smit and Pilifosova, 2003).

Exposure is defined as the degree to which a system experiences environmental or socio-political stress (Adger, 2006). To exemplify: how may rainfall increase in a particular period or how may droughts be prolonged? Sensitivity refers to the extent to which a system is modified or affected by such stress. For example, how many more people are at risk of getting malaria with increased rainfall? (ibid: 270). Adaptive capacity refers to a system’s ability to cope with and adapt to these changes. For example, what are people’s capacities to reduce the risk of attracting malaria? Clearly, these elements are highly inter-related and there are broad social, economic, political and ecological conditions that affect all three elements to varying degrees. Complexity is thus a key feature of vulnerability, since it is a dynamic system of linked components in continuous flux. Uncertainty is also a critical factor affecting the system, since we are

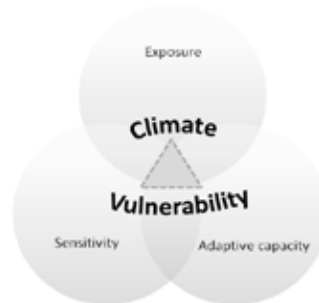


Figure 1. Compound elements of climate vulnerability.

not only studying present vulnerabilities but also future potential impacts, where our knowledge is limited by data based on *anticipated* changes, rather than actual.

This temporal dilemma can be tackled by using the actual context-specific and process-sensitive empirical material that we do have and analyze it through theoretically informed reasoning, so called retroduction (Ragin and Amoroso, 2011).

There are (at least) two distinctive camps of vulnerability research. The first, referred to as outcome vulnerability (O'Brien et al., 2007), has grown out of various risk-hazard and impact frameworks (see Fussel and Klein, 2006). It focuses on the *impacts of climate change* in terms of measurable units on various sectors in society. The second, contextual vulnerability, proceeds from the constructivist literature on entitlements and livelihoods frameworks (see Dreze and Sen 1991; Sen 1999; Watts and Bohle, 1993; Ribot et al., 1996; Adger, 2006). It focuses on the *variation and dynamics of vulnerability within and between social groups* in society thus emphasizing aspects of inequality and distribution. Our conceptualization of *climate vulnerability* draws upon both of these frameworks in an effort to relate exposure, sensitivity and adaptive capacity to each other in an *integrated* manner, as called for by Hinkel (2011). This is demonstrated in our interactive work on seasonal calendars (Fig. 6), which we see as a novelty and thus a contribution to the vulnerability debate in climate research.

Analytical framework and integration of field methods

Drawing on Schröter et al. (2005) and adapted to our study context, five criteria guide our climate vulnerability analysis. First, we include a multitude of different types of data, thus necessitating and allowing for interdisciplinary research and inclusion of non-scientists. Second, and following Cutter et al., (2003), we understand vulnerability as place-based and context-specific, hence the need to pay attention to the *nesting of scales*. Third, we recognise multiple socio-ecological stressors and feed-back mechanisms, which we attempt to capture in the seasonal calendars. Fourth, we allow for differential adaptive capacities and thus identify the barriers and constraints within the human-environment system that make it possible for *some* to adapt but others not. Fifth, we follow the principle that empirical material must be both historical and contemporary while also providing a prospective potential. Hence, our data covers statistics, conceptual modelling and oral histories that enable identification of historical patterns and future predictions. Besides laying the foundation for our analytical framework these criteria influenced our research strategy and guided the choice and design of our field methods.

The article draws on research and data from repeated fieldwork in 2007-2011. The study is predominately qualitative, based on various types of interviews and focus groups, participatory exercises and a multi-stakeholder workshop but also includes certain crucial quantitative information such as a household survey and rainfall data

(Table 1). Four smallholder farming communities (Onjiko, Thurdubuoro in Kenya and Kunsugu, Kisumu in Tanzania) located in the coastal low-lying provinces of Nyanza, Kenya and Mara, Tanzania (Fig. 2) participated in the study.



Figure 2. Map of the LVB with marked study sites (Source: ILEC, 2005).

Local stakeholders have been involved in our research at several junctures to give us the opportunity to test, evaluate and verify initial empirical findings. This also enhanced the iterative process by allowing empirical data to be revised and revisited throughout research. Initially, this was done through interviews with stakeholders, specifically farmers themselves, but also other informants working locally such as health care practitioners, representatives from non-governmental organizations (NGOs) and politicians, i.e. location chiefs or ward executive officers. And later on, through the organization and execution of a multi-stakeholder workshop intended as a first step to raise awareness and open up a critical dialogue about climate adaptation. Importantly, it also served to increase collaboration between high-end stakeholders themselves as well as between them and local farmers.

Time	Methods	Sampling	Respondents		Purpose
			KENYA	TANZANIA	
Sept-Oct 2007	Semi-structured interviews	Key informants working on vulnerability related issues	U of Nairobi, UNEP, Sida, CARE, ILRI, ICRAF, ACTS	U of Dar Es Salaam, ViAFP, CEEST	Key issues in smallholder farming in the LVB, predicted climate change and impacts, response strategies.
	Household survey	HH randomly selected based on: exposure to drought/flood and engagement in agroforestry	100 HH in two locations; Onjiko and Thuridibuoro,	100 HH in two wards; Kisumwa and Kunsugu	Demographics, livelihood activities and assets, agroforestry practices, climate information and impacts, coping mechanisms, assistance.
Oct-Nov. 2008	Informal Open-ended interviews	Extension officers at Vi-Agroforestry	One working in Nyando district	One working in Musoma district	Outlining features of the place. Identifying resource use. Locating droughts and floods. Discussing cultural traditions and practices, and the moral economy. Tracing land rights and land tenure.
	Narrative walks	Location chiefs in selected locations/wards	One each in Onjiko, Thuridibuoro (n=2)	One each in Kisumwa and Kunsugu (n=2)	Comparing changes in resource use, livelihood activities and landscape over time. Identifying networks and informal groups.
	Episodic interviews	Elderly farmers above 60 years of age selected randomly from among the respondents in HH survey	Onjiko (n=3), Thuridibuoro (n=3)	Kisumwa (n=3) Kunsugu (n=6)	Comparing life today with the situation 10 years ago, 20 years ago, and their childhood regarding: climate, income sources, health agricultural production and marketing, social networks, access to natural resources, labor responsibilities, coping strategies
	Focus group discussions	Two groups with women; two groups with men and women (n=8 per group)	One each in Onjiko and Thuridibuoro	One each in Kunsugu and Kisumwa.	Identifying perceptions on climate induced changes. Perceived impacts on livelihoods and range of responses both short and long term
2008-09	Precipitation data	Where local data was available	Kisumu Airport, Ahero, Kibos and Awasi stations	Musoma Airport and Tarime station	Monthly and daily rainfall data between 1951-2008
Sept. 2009	Interactive mapping of seasonal calendars	Same groups as used in the FGD's, 2 with women only	Thuridibuoro and Onjiko, (n=10 and 15)	Kisumwa and Kunsugu, (n=15 and 30)	Mapping of climate, health, income, expenditure, food production and consumption in an average year.
January 2010	Multi-stakeholder workshop (2 days)	LVB stakeholder from both Kenya and Tanzania Held in Kisumu Kenya	KARI, KEFRI, KEMRI, U of Nairobi, Kenya Seed, Equity Bank, Maseno Uni, ILRI, KMFRI, Sida, farmers from Thuridibuoro and Onjiko (n=45)	LVDC, Vi-AFP Musoma and Rwanda, LVEMP, Red Cross, Farmers from Kisumwa and Kunsugu (=20)	Identifying impacts of climate variability and change on local communities. Identifying current coping and adaptation strategies, alternative future pathways, synergies and future needs for collaboration between existing actors.
Jan 2011	Focus group and individual interviews	Widows, snowball sampling for interviews and 1 group, the other revisit (n=7/grp)	Onjiko		Challenges and opportunities of being a widow in a small holder context

Contextualizing climate vulnerability in the LVB

The most fundamental connection between natural systems and human well-being in the LVB appears to be smallholders' heavy dependence on biophysical assets for their livelihoods. Barrett (2008) argues that when the key state variables of two systems are shared then strong interdependence follows automatically. Emerging questions relate to the nature of these interrelationship(s) and the balancing or reinforcing feedbacks within and between systems. In the studied communities, people rely on rain-fed mixed agriculture based on labor intensive small-scale farming and livestock rearing. Drawing on the 'Baseline household survey' (Gabrielsson 2007) we see that farmers grow a wide range of crops such as maize (staple in Onjiko and Thurdibuoro) and cassava (staple in Kisumwa and Kunsugu), cow peas, millet, rice, sunflowers, various vegetables and in some instances cash crops like cotton or water melons, farmed on small plots, ranging between 0.5 to 3 acres on the Kenyan side and 0.5 to 6 acres in Tanzania. The majority also keep poultry, goats, cattle and dairy cows in varying small numbers. Fuel-wood is the primary energy source and water for domestic and productive needs come primarily from nearby rivers, streams and/or built water ponds. Farmers also engage in a number of off-farm activities to secure cash.

Despite tremendous advances in agricultural science and technology, climate and weather are the most important variables in food production (Rosenzweig et al., 2001). Since rain-fed agriculture is the mainstay of peoples' livelihoods in the study region, any change in the pattern of rainfall contributes to a destabilization of the food system, in terms of influencing production, use and/or access to food with potentially negative feedbacks on livelihoods (Misselhorn, 2004; Ingram et al., 2010). Grasping the dynamics of rainfall in the LVB is therefore fundamental for our understanding of how it induces stress on the coupled human environment system.

Locating exposures

The bi-modal rainfall pattern constitutes a primary parameter around which agricultural and herding activities are organized in the East African region (Smucker and Wisner, 2008). This pattern is associated with interlinked, complex, and not yet fully understood climate drivers, such as the movements of the Inter-tropical convergence zone, the large scale (African) monsoonal winds, the El-Nino Southern Oscillation phenomena (ENSO), the quasi-biennial oscillation, the meso-scale circulations and extra-tropical weather systems (Kizza et al., 2009). According to both elders and contemporary farmers the long rainy season (*masika*) normally spans March-May, while October signals the onset of the short rainy season (*vuri*) that generally lasts until mid December (Field data, 2007-2010). During some periods

the inter-annual rainfall variability is extreme, leading to heavy downpours and/or prolonged dry periods, often linked to the ENSO phenomena (Ogallo, 1997; McHugh, 2006). Despite the generally complex climate parameters involved in analyzing the rainfall dynamics in the LVB, recent regional climate studies have succeeded in identifying an overall positive trend indicating a rise in rainfall, specifically during the short rainy season (Kizza et al., 2009; Thornton, 2010). Our analysis based on time series on monthly rainfall from two stations and used as a proxy for the study sites in Kenya and Tanzania, although not uniform across the two, indicate a similar trend, specifically during the short rainy season. In addition, we also see a deviating trend in the long rainy season compared to the past, whereby rainfall is increasing slightly in January but decreasing in February and April. Figures 3 a-f illustrate this trend based on precipitation data from Kisumu and Musoma from 1951/59 to 2008.

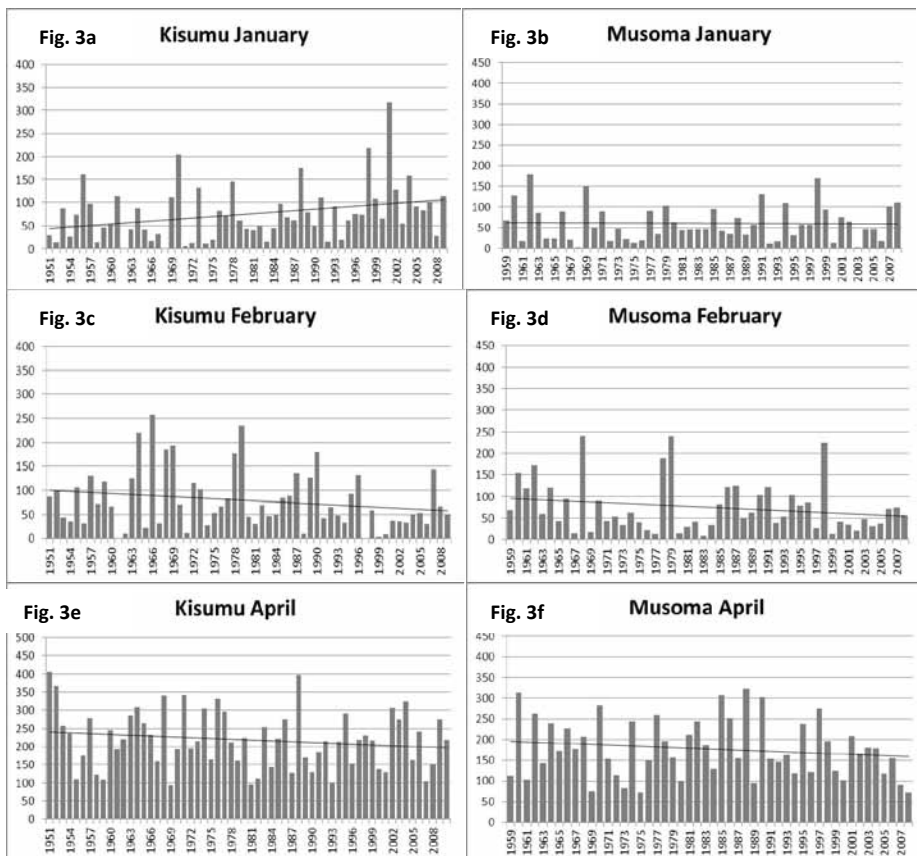


Figure 3 a-f. Rainfall trends from 1951/59 to 2007/2008 for the months of January, February and April at Kisumu and Musoma meteorological station (Source: Kenya Meteorological Agency and Tanzania Meteorological Services, 2008).

Although seemingly small changes, such changes may be critical to farmers because of the way it dictates agricultural performance as illustrated by farmers' own experiences below:

We cannot predict when it will rain anymore. Now we don't have a fixed time when we plant, we have to read the weather to know when to plant. Because of the change it has made life much more difficult, so it is all dependent on trial and error (Tom, Oct. 29th 2008, Kenya).

The rainfall was better in the past compared to today. Now the rains are not enough for our needs. The rains are much more unreliable today (Taabu, Nov. 12th 2008, Tanzania).

It rains more heavily now when it rains than before. It is now destructive. Before when it rained it was not as heavy and then it was useful for the farm rather than now when it cannot be utilized by the soil (Wilfrieda, Oct. 27th 2008, Kenya).

It is the timing of the planting of the crop that is key. In the past everyone would plant their crops in February because they were targeting the long rains in April. But now in April there is very little rain so it means that they do not get enough harvests (Joseph, Oct. 23rd 2008, Kenya).

In the past it rained a lot and the season was longer and we could harvest as planned (Kiega, Nov. 17th 2008, Tanzania).

In the past the rain followed the season but now it does not.... [Today] rain ends before the growth of the seedlings are finished. Now we are just guessing when we should plant (Paul, interview 14th Nov. 2008, Tanzania).

People do not know when to plant anymore. They may plant and then crops are destroyed and then they have to plant again (Rose, Oct. 23rd, 2008, Kenya).

The quotes above draw direct attention to the delicate balance between rainfall and plant growth and how that determines the success or failure of crop production. Understanding the way farmers interpret rainfall dynamics is therefore important as an indicator of exposure to climate vulnerability. By using only a meteorological definition of drought to interpret impacts on agricultural production we would potentially overlook farmers' broader perception of what is known as 'agricultural drought' (i.e. soil water drought) which occurs when there is lack of soil water in the root zone to sustain crops and pasture between rainfalls (Slegers and Stroosnijder 2008). While agricultural drought is not as drastic as meteorological drought, it is still a partial cause of loss in crop productivity and may also reduce viable grazing land,

spread new pests and subsequently change livestock production strategies (Smucker and Wisner, 2008). This complex bio-geo-physical interaction seems to reinforce farmers' *sense of drought* and/or intense rainfall (UNEP, 2006; Slegers and Stroosnijder 2008). Since soils in the study areas have low fertility, poor texture and are used intensively (Odada et al., 2009; Swallow et al., 2009) we argue that the combination of these factors and livelihood outcomes help explain why farmers' perceive rainfall as unpredictable or unreliable because it is simply no longer favourable to their food production needs.

Locating sensitivities and differential adaptive capacities

Historically favourable rainfall combined with an abundance of fertile soils made the LVB an attractive region to inhabit (UNEP, 2006). But this historical suitability for farming has also led to a rapid growth in population density, from 1 million in 1960 to more than 30 million today and expected to reach 53 million by 2025 (Wandiga, 2006). This population pressure has resulted in a fragmentation of agricultural land; for instance individual farming plots along the Kenyan side of the basin have decreased from 2.75 hectares per person in 1975 to 0.5 hectares in 2004 (UNEP, 2006). Our survey reveals that farmers in our study areas have even smaller plots some even less than three acres per *household* (See Table 2).

Estimated land size acres/household	>1 acre	20 %
	1-3 acres	45,5 %
	3-6 acres	17,5 %
	<6 acres	12,5 %
Animal protein intake days/week	0 days	4,5 %
	1-3 days	55,5 %
	4-6 days	25,5 %
	Every day	14,5 %
Food sufficiency months/year	1-3	24,5 %
	4-6	29,5 %
	7-9	20 %
	10-12	23,5 %
(Source: Baseline survey, Sep-Oct 2007)		

Demographic changes and reduction in land holdings have necessitated an intensification of agricultural production throughout the region, so also in Onjiko and Thurduuro where shifting cultivation of diversified crops have been replaced by predominately sedentary mono-cropping. In Kunsugu and Kisumwa, areas with former heavy livestock rearing, the number of livestock per family has dropped significantly and reliance on food crops is now higher than in the past (Field data 2008). These shifts have also contributed to the expansion of invasive weeds and a further loss of crop productivity (Smucker and Wisner, 2008). To keep up food production farmers have

responded to these negative feedbacks by increasing labor activities, such as weeding, during intense periods of the growing season. But availability of labor is not easy for everyone to secure, as Jane explains:

Manpower is lacking now. Only parts of the farmland is tended in the way I want and thus yields are not as high as they could be (Jane, 29th Oct. 2008, Kenya).

Moreover, strenuous labor requires well nourished and healthy individuals. Our study indicates that the majority of people are neither. In fact, the population is sensitive to several vector and water borne diseases, many with clear linkages to climatic conditions, including, but not limited to malaria, typhoid, dengue fever, schistosomiasis, cholera and trachoma (Focus groups 2009).

[In the past] we could fetch water from the river and drink it. There were no diseases like dysentery, cholera and malaria like today (Wilfrieda, Oct. 27th 2008, Kenya).

Table 3. Percentage of households afflicted by climate-water related diseases in 2006 (n=200)	
Malaria	90 %
Dengue fever	24 %
Diarrhoea	9 %
(Source: Baseline survey, Sep-Oct 2007)	

Being the worst and most common disease, malaria affects nearly every family in any given year (Table 3), thereby making it endemic and the leading cause of mortality and morbidity in both children and adults in the basin (Wandiga et al., 2006). Farmers also indicate a rise in incidence of the disease and its presence on a year round basis:

Nowadays malaria is a bigger problem, making people sick more often (Neema, Nov. 17th 2008, Tanzania)

According to Githeko (2009) this rise may be linked to increasing rainfall variability, which contributes to the spread of mosquito habitats across time and space. Cholera is also endemic to the LVB but the frequency and severity of episodes have increased in the last 20 years, explained in part by climate changes (Wandiga, 2006). People most at risk are those who drink untreated water from Lake Victoria or its tributaries, have poor sanitation and share food with already sick individuals, especially at funeral feasts (Olago et al., 2007). Since, most farmers in our study areas rely on these freshwater sources for their productive and/or domestic water needs and regularly attend funerals they are highly sensitive to contamination. This imminence to periodic climate-associated ill-health is compounded by the high prevalence of HIV/AIDS in the basin, estimated to be as high as 15 percent of the population on the Kenyan side and even higher among widowed and divorced women (Okuro, 2008). Widowhood is a social condition that invariably, and for various reasons, increases sensitivity to other diseases, according to several widows in our study. Yet, by some it is also seen as a window of opportunity for working together with other widows to achieve social change (Gabrielsson and Ramasar, 2012).

Sensitivity to diseases is also linked to a non-varied diet, rich in carbohydrates (maize and cassava) and low in animal proteins (Table 2), which leads to micro-nutrient deficiencies and a subsequent weaker immune system that enables and prolongs sickness (FAO, 2003). Health of individuals could therefore be considered the most important asset controlled by farmers, in fact a capability (Sen 1999). But due to the amount and endemic nature of the climate-associated diseases in LVB, avoiding and preventing disease is difficult and this initiates yet another negative feedback loop, which even further erodes one's basic bodily functions and limits the capacity to work, learn and subsist (Dasgupta 1997, Paavola, 2008). In our study areas there is, however, a significant lack of males in the age bracket 19-35 (Figure 4), indicating that the HIV/AIDS pandemic along with other deadly diseases mentioned above have already had palpable effects in transforming the composition of families in the region. This is a highly important deficit considering the lost opportunities and potential that younger working age males can provide in terms of muscle power and/or non-farm incomes.

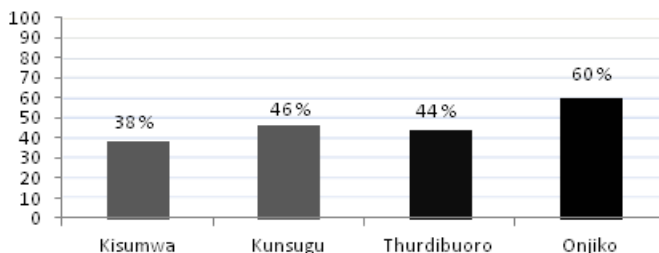


Figure 4. Percentage of households without males between 19 and 35 years of age.
(Source: Baseline survey of a total of 200 households, Sep-Oct, 2007).

Able-bodiedness (Cleaver, 2005), land and livestock, as we have seen are thus important livelihood assets in this rural context of smallholder farming. These livelihood assets or entitlements/capabilities (Sen, 1999) and/or forms of capital (Scoones, 1998; Bebbington, 1999) generally divided into natural, financial, physical, human, social, cultural and institutional assets, are identified as the adaptive capacities that allow for livelihood survival and adaptation. Accordingly, the more capital and capabilities people command in the right mix and with the right strategies, the greater their capacity to buffer themselves against external shocks (Moser, 1998). Nevertheless, capacity to adapt is neither collective nor static but rather an individual and dynamic process, influenced by cultural norms and the enabling/disabling environment of the community, which furthermore is reflective of the available resources and political economy of the region (Ribot et al., 1996; Yohe and Tol, 2002; Smit and Pilifosova, 2003). In our study setting, as elsewhere in rural areas of Sub-Saharan Africa, farmers' rights and responsibilities are highly gendered, thus adaptive capacities are also gender differentiated (Masika, 2002; Denton, 2002;

FAO, 2006; Demetriades and Esplen, 2009). As a result, the adaptive capacities of the so called dependants that women are deemed responsible to care for (the elderly, the young and the sick) are also differentiated since they too have limited abilities to obtain and exploit key livelihood assets controlled by adult men (Enarson, 2000; Gabrielsson and Ramasar, 2012). Our survey shows that in Tanzania women generally have more dependants (elderly and young children) to care for compared to Kenya. Figure 5 illustrates this difference by comparing the population pyramids for Kunsugu and Thuridibuoro respectively.

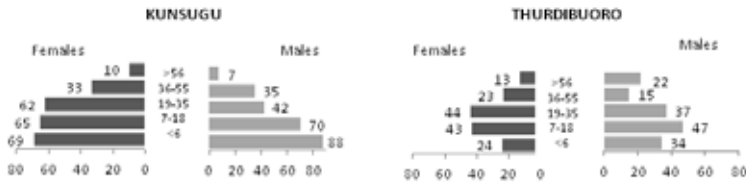


Figure 5. Demography in Kunsugu and Thuridibuoro by age group and sex.
(Source: Baseline survey of a total of 200 households, Sep-Oct, 2007).

In Kunsugu the number of children under the age of six is 157, compared to only 58 in Thuridibuoro. Whereas the number of children in the past signified wealth and high status (Gunga, 2009) today many farmers, especially women, wish to have fewer children because of the increasing expenses associated with them, in terms of health care, food, school fees, supplies and uniforms (Focus groups 2008 and 2011). According to data from focus groups, a common way of 'balancing' the household budget in all four communities during times of hardship, is therefore to withdraw children from school or in extreme cases, as exemplified in Kunsugu, marry off young females (between 12-15) to reduce expenditures and mouths to feed (Field data, 2008).

The great majority of farmers have identified the problems of lacking manpower, dwindling food production and declining soil fertility but only a limited number of them have taken action. By employing their primary asset, themselves, and joining hands some farmers are able to plan, save and work collectively to intensify food production. The benefits of these collective action groups have proven to be many, including more time and resources available for long-term diversification, preventative activities, experimentation and resource conservation (Andersson and Gabrielsson, 2012). However, the scaling up of this seemingly viable adaptation strategy, may be hampered by the fact that the existence of and access to such formalized groups are currently divided along gender and ethnic lines, marginalizing some and excluding others (Field data 2008-2011).

Seasonal pattern of hardship and coping

While the elements of climate vulnerability are interesting to identify in isolation, their integrated effect are probably more significant, albeit less widely discussed. Accordingly, and inspired by Hutchinson's (1998) diagram on available household strategies in times of famine, we asked farmers to describe their annual pattern of livelihood activities and stressors including climate (rainfall and temperatures), health (disease affliction), food consumption (degree of insecurity) and expenses (on basic needs including food). Similarly, we mapped their agricultural and animal husbandry activities and the annual distribution of on- and off-farm incomes and then combined the participatory exercise results from all four communities into a generalized seasonal calendar. While individual factors, such as incidence of diseases and food costs differed between communities, a similar *pattern of hardship* could be identified in all study locations for a *typical year*. The core of the calendars thus reflect farmers' general consensus of a 'conventional' bimodal rainy season, irrespective of the observed and perceived changes in rainfall dynamics in recent years.

The 'wheel of hardship', seen in Figure 6, is a summary of these findings indicating that livelihood conditions and activities differ considerably throughout the year rendering farmer households more or less exposed and sensitive to climate induced stressors and with more or less capacity to cope with impacts. Interestingly, comparisons of data from the four sites show that conditions differ more throughout the year than between locations.

When integrating the results two key periods of severe livelihood hardship can be identified; January-March and October-November. Within these, January and February are the worst hardship months because climate exposure coincides with increased sensitivity to diseases and limited buffers, due chiefly to lack of food and income opportunities enforced by high expenditures for food, school fees, medical needs, renting of grazing land and hiring of agricultural labor. Similar conditions apply to the months of October and November but are usually less severe since households still have staple crops left from the previous harvest and can sell vegetables just harvested.

Fortunately, periods of recovery also exist, the main taking place between May and August. From data we learn that crops have matured, fish are abundant in lakes and streams which mean that caloric (and protein) needs are met while crops can be sold and even possibly stored. Grazing land is also lush and green so extra costs for animal feed is not a problem. Subsequently, families who can afford it, make major household investments, including purchases of livestock, house construction materials, clothes, agricultural tools and seeds. Medical check-ups and veterinary visits are also common. Organized farmers, mostly women, also repay debts and make significant contributions into micro loan and saving schemes, which they later

can use during hardship periods. The buffering potential is however dependent on crop performance and local market sale prices, which in turn is dictated by rainfall, setting limits for the potentials of the harvest in this rain-fed agriculture.

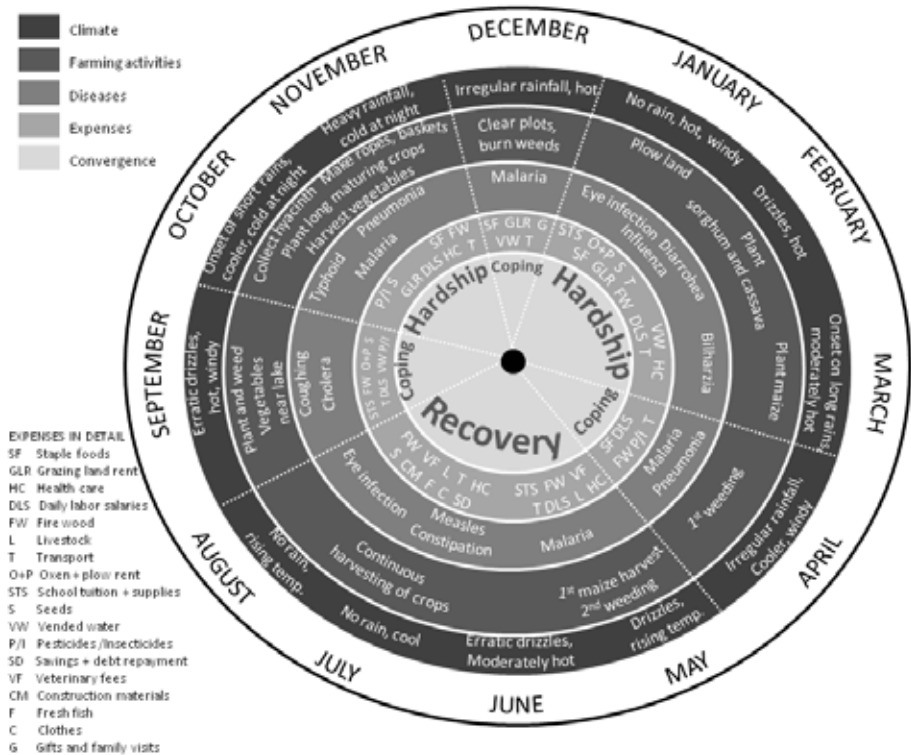


Figure 6. 'Wheel of hardship' – a generalized seasonal calendar illustrating livelihood conditions and stress based on participatory exercises with smallholder farmers from four communities in the LVB.

During the remaining months of the year (September, December and April) households are again under pressure due to rapidly declining food supplies while simultaneously having to spend much time on weeding and clearing land. But since rainfall is less intense and disease burdens are lower throughout these months households have easier to cope. During hardship periods, however, these buffers are not available and hunger is looming, which forces many households to drain their liquid assets in an effort to relieve livelihood stress. Figure 7 illustrates the order of these employed mechanisms; and interestingly, they follow a similar and recognizable pattern, which was formerly followed mainly during severe droughts and famines (see Hutchinson, 1998).

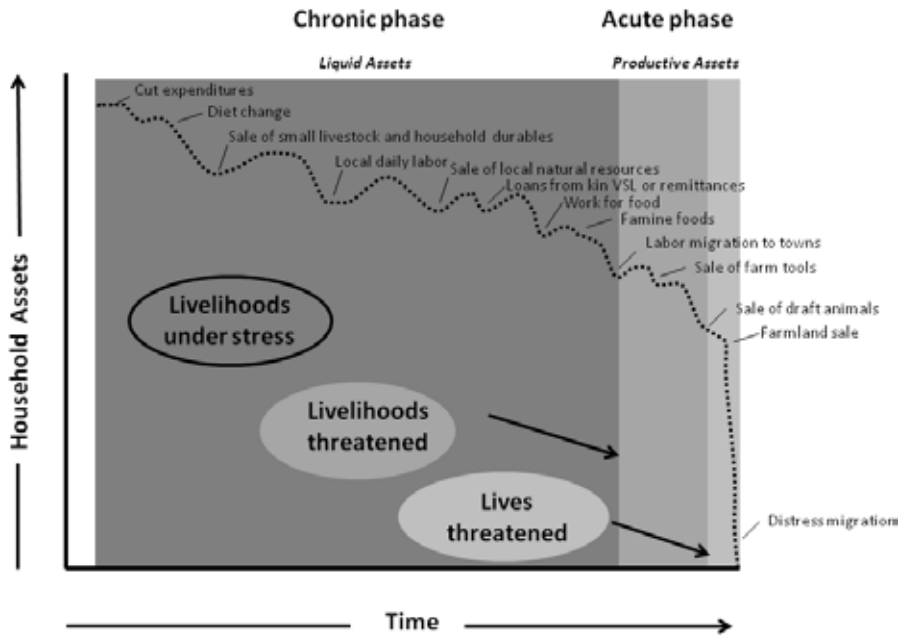


Figure 7. Generalized pattern of coping with climate variability and change. The figure is based on focus groups with smallholder farmers from four communities in the LVB. Adapted from Hutchinson (1998) and modified by the authors.

Today however farmers employ these coping mechanisms on a more regular and recurring basis (Focus groups 2008-2009). This, we argue, signifies that a substantial shift in the degree of livelihood stress is currently underway among rural smallholders in the LVB. Away from occasional and sudden hardship periods, caused by temporary climate extremes (meteorological droughts and floods), towards livelihoods driven and characterized by recurrent and persistent agricultural drought and subsequent chronic livelihood stress. Similar changes have also been observed in other rural smallholder settings. For example, Smucker and Wisner’s (2008) study in Tharaka, Kenya, demonstrates that the variety of coping mechanisms employed by farmers have dropped considerably compared to 20 years ago. In a study from northern Tanzania Traerup and Mertz (2011) show how contemporary farmers are increasingly relying on similar and sometimes competitive strategies, with increased livelihood stress as a result. Similarly, in Kisumwa diversification through specializing in beer making and charcoal production is a key to coping among women, as a means to increase household incomes during hardship periods, while in Thurdubuoro and Onjiko diversification through sales of ropes, baskets, dried fish and tomatoes are common. A difficulty with such widespread reliance on similar coping mechanisms in one and the same community, in combination with a narrowing of

overall strategies, leads to a decline in available natural resources and the saturation of home made products in the local market place (Field data 2008-2009). Not only does this reduce everyone's income potential and margins, but also the viability of the coping mechanisms as such. A lack of other alternatives may, however, explain this reliance on diversification. Along with land becoming infertile and fragmented, expansion of agriculture has become unfeasible in the LVB, similarly, migration is no longer as attractive to farmers as it used to be because the competition for unskilled work has increased between ruralites and the urban poor (Field data, 2008-2010) as also noted by other scholars in similar Sub-Saharan settings (Bryceson, 2002; Cleaver, 2005, Ellis and Freeman, 2005). Intensification is still a possibility, but in the short term it demands increased labor power and in the long-term deepened agricultural knowledge to make management sustainable (Pretty et al., 2011), both of which are currently in short supply in the communities we have studied (Andersson and Gabrielsson, 2012). Hence agricultural diversification will likely play a key role also in the future in order to manage chronic livelihood stress. But whether or not it is a sustainable adaptation strategy and viable for everyone, is still uncertain, given the current reliance on similar strategies and the differential adaptive capacities to manifest those adaptations. Moreover, there may be limits to how much one can diversify due to the (often) increased labor burden, limited market integration and lack of transport infrastructure (Eriksen et al., 2005; Miles 2007).

Three lessons, with significance for our understanding of climate vulnerability, can be drawn from this analysis. Firstly, small holder livelihoods are increasingly becoming separated from their natural surroundings, because the majority of natural resources needed for basic livelihood survival are either no longer available or no longer accessible to them, other than in the cash based market economy. This means that small-holding farmers today have mainly become *consumers* in rather than producers for the local market. This is illustrated by this quote from one of the farmers interviewed:

Life is harder now, everything needs money. In the past people were exchanging food with each other, food was available at all times (Paul, Nov. 14th 2008, Tanzania).

Consequently, due to recurring, yet variable shortages of home grown food in all four communities throughout the year (Table 3), farmers are not only dependant on purchasing food they also buy fuel wood, seeds, vended water at times as well as rent grazing land in order to survive, resources that in the past were produced and/or collected directly from natural surroundings. This monetarization requires families to ensure a steady flow of cash into the household. Particularly important is securing money to buy staple foods, since that eats the biggest share of budgets in the studied households (Field data, 2008, 2009). But staple food crops have inelastic

supply and demand (there are no alternative substitutes and urgency to fulfil basic caloric needs are high) so even a small change in actual or expected supply results in a large change in market prices (Minot, 2010). Volatile food prices thus puts buyers as well as sellers at the mercy of the market, which makes budget planning difficult, both in predicting future costs but also in anticipating potential profits, as explained below by the ward location chief in Kisumwa.

Prices of the produce are increasing. Of course farmers are getting more for their produce but because they are producing less they are actually also getting less money for it today than in the past. A sadolin (4 kg) of maize cost 500 Tsh three years ago and now 1900 Tsh. Cassava was 300 Tsh three years ago and 1200 Tsh today (Kisumwa ward location chief, Nov. 12th 2008, Tanzania).

The geographical location of the farmers in our areas, far from high food producing areas, capital markets and international ports together with an instable food production of their own make farmers here particularly exposed to both temporal and spatial price volatility (Minot, 2010). And as net buyers of food during hardship periods such volatility have adverse affects, forcing many to limit their meals and/or change their diets to so called famine foods and/or sell household assets, including valuable livestock, at a loss (cf Hutchinson 1998).

The second lesson relates to the existence of and many 'costs' of the recurring incidence of climate-associated diseases on farmer livelihoods. Besides personal trauma and tragedy, diseases cause direct impacts on households through incurred health care costs or paying for funerals. Indirectly ill-health may thus lead to loss of anticipated non-farm incomes and added costs of hiring agricultural labor when manpower is reduced or lost. Moreover it also adds to women's labor burdens, as caregivers of the sick (Gabrielsson and Ramasar, 2012). In an area where labor power can arguably be considered a key limiting factor for agricultural intensification the implications of ill-health is thus far reaching, not only to individual livelihood security but perhaps more importantly, for the sustainable development of the region as a whole.

The third lesson relates to the uncertainty of coping with hardship in the future. As the wheel of hardship illustrates there is today a delicate balance between coping, hardship and recovery periods. Currently most farmers have some adaptive capacities that enable them to respond to climate induced stressors, albeit at a cost, and with no evidence of achieving reductions in current climate vulnerability. But the insights on a narrowing of the variety of coping mechanisms, coupled with the observed and experienced changes in rainfall dynamics, draws our attention to the pending difficulties and uncertainties of maintaining this status quo in the future. As a result, even subtle disturbance in the wheel of hardship may cause farmers to slide into greater climate vulnerability.

Concluding discussion and policy implications

Using an integrated mode of inquiry we have explored and synthesized the three essential, yet theoretically vague, components of climate vulnerability by applying them in a rural farming context in the LVB. Through a range of methods we have thus contributed an empirically grounded and theoretically informed understanding of climate vulnerability. With our seasonal calendars, explicitly building on our field data and design, we are able to study the temporal interactions between nature and society, and thereby considering climatic, agronomic and disease dynamics in a place-based setting, as suggested by (Thomson and Scoones 2009). From this we show that time and timing are significant for understanding exposure, sensitivity and adaptive capacities in any attempt to contextualize climate vulnerability. Not only does this exercise generate insights on how these stressors are interrelated, i.e. how they feed into and off each other by contributing to different sensitivities at different times of the year, depending on the type of exposure. Moreover, it also illustrates that when exposure, sensitivity and limited adaptive capacity converge in time climate vulnerabilities are greater because of destructive reinforcing feedbacks on the human-environment system. In addition, we also show that farmers engage in continuous, yet reactive and autonomous adaptation to climate vulnerability by relying on past experiences of dealing with climate extremes, despite their waning viability in times of increasing climate uncertainty. Current differential adaptive capacities between households and communities indicate a deficit in adaptation potential among smallholder farmers in the LVB, which makes life especially troublesome and the future highly uncertain. In all this, age and gender are pronounced aspects of the capacity of a person, a household or a community to cope with climate induced impacts, not to mention increasing the adaptive capacities to reduce climate vulnerability.

The wheel of hardship underscores household's reliance on a steady flow of cash, food and (healthy) labor power to manage converging aspects of exposure and sensitivities. Historically, farmers have often managed this through increased diversification, which is also seen as a strategy emphasized and promoted by the World Bank (WB, 2008). However, our study illustrates that livelihood diversification at household levels is becoming increasingly undermined as a livelihood strategy and the alternatives, in terms of migration and extension of agriculture, now offer only limited opportunities. The only other feasible adaptation strategy for the LVB is therefore to intensify agricultural production. But as previously mentioned this hinges not only on peoples' ability to pool labor but also on increased knowledge about how to farm more sustainably in times of global environmental change (Pretty et al, 2011). To enable farmers to do this clearly requires governmental action and financial investments. However, for the 2011/2012 fiscal year governmental spending on the agricultural sector in both Kenya and Tanzania was low, 3.53 per cent in Kenya, down from 4.7 per cent in 2009/2010 and 7.7 per cent in Tanzania, up

from 6.4 percent in 2008/2009 (Ngombalu, 2011: 6-8), despite the fact that a majority of its citizens are involved in farming (IFAD, 2011).

More importantly, both countries' national adaptation responses (Tanzania National Adaptation Plan of Action 2007, 61 pp.; Kenya National Climate Change Response Strategy, 2010, 120 pp.) acknowledge that recent climate extremes as well as anticipated changes in climate dynamics in the future, will hit the agricultural sector the hardest. Furthermore they emphasize the importance of guaranteeing food security to enable economic development. Yet, none of the proposed strategies to increase adaptive capacities within the agricultural sector involves or even mentions the role of gender inequality, the fragmentation of land or the limited labor compared to the labor needed for agricultural intensification to take place. The budget proposal in Kenya's strategy further reveals that only 4.5 per cent of the total 236 billion Kenyan shillings have been allocated for agriculture; 1.1 per cent for gender, children and social development; and 0.5 per cent for public health. One could therefore argue that the proposed adaptation policies to cope with and reduce the vulnerability to climate variability and change are contradictory, since only a fraction of the proposed budget and no specific programs reflect priorities to increase the livelihood security of those most disproportionately affected. As Deveraux and Edwards (2004: 28) so poignantly puts it; "the extent to which climate change is taken seriously and is effectively addressed depends primarily on political will". In regard to the national responses to the predicaments of small holders in the LVB such political will seems to be lacking.

Clearly, our study findings indicate that reducing climate vulnerability among smallholders in the LVB must involve a multitude of policy responses by various stakeholders including but not limited to: *increasing adaptations to reduce sensitivities*, by for example, investing in water and sanitation, adopting drought and flood resistant crops and engaging in sustainable land management practices, such as integrated pest management, agro-forestry, soil conservation and livestock management, as well as *enhance the ability to cope with present climate variability and future climate uncertainty* among those who currently have less adaptive capacities to do so, i.e. female headed households, households lacking able-bodied men of between 19-35 years of age, households with many dependants and households with many sick family members.

In order to implement this in practice, and in contrast to the national adaptation policies proposed by the governments in Tanzania and Kenya, but in agreement with IFAD recommendations (2011) we therefore suggest a gender-informed and three partite integrative policy strategy with focus on: (1) financial and infrastructural support to scale up adoption of locally produced and affordable technologies and innovations, (2) education and extension services targeting and promoting a shift

towards sustainable agricultural intensification, and (3) capacity building and social learning initiatives to encourage the integration of “marginalized” climate vulnerable groups into collaborative projects and collective action groups to reduce labor burdens and diversify activities and income earning possibilities. In so doing, three important livelihood domains may be promoted and developed: the capability to farm collectively; the means to increase household buffers; and the empowerment of individual agency to enable planning for the uncertainties ahead.

Acknowledgements

We are grateful for financial support from the Swedish International Development and Cooperation Agency Sida. The authors would like to thank all stakeholders participating in the Kisumu workshop and SCC-VI Kisumu for arranging and co-hosting the event. Many thanks also to the farmers that engaged in the participatory exercises. Without you this research would not have taken place.

References

- Andersson, E and S. Gabriëlsson (2012) ‘Because of poverty we had to come together – Collective action as a pathway to improved food security in rural Kenya and Uganda’ *Journal of International Agricultural Sustainability*. DOI:10.1080/14735903.2012.666029
- Adger, W.N., (2003) ‘Social capital, collective action, and adaptation to climate change’ *Economic geography* 79(4): 387-404.
- Adger, W.N. (2006) ‘Vulnerability’ *Global Environmental Change*, 16 (3), 268–281.
- Barrett, C.B. (2008) “Poverty traps and resource dynamics in smallholder agrarian systems” in *Economics of Poverty, Environment and Natural-Resource Use*. R. B. Dellink and A. Ruijs eds. Springer.
- Bebbington, A. (1999) ‘Capitals and capabilities: A framework for analyzing peasant viability, rural livelihoods and poverty’ *World Development* 27(12): 2021-204
- Brooks, N. (2003) ‘Vulnerability, risk and adaptation: A conceptual framework’, Tyndall Centre Working Paper 38, Tyndall Centre for Climate Change Research, Norwich, UK.
- Bryceson, D. (2002) “Multiplex livelihoods in rural Africa: recasting the terms and conditions of gainful employment” in *The Journal of Modern African Studies*, Vol. 40., No. 1., 1-28.
- Clark, W. C. (2007) ‘Sustainability science: A room of its own’ *PNAS* 104(6): 1737.
- Cleaver, F. (2005) ‘The inequality of social capital and reproduction of chronic poverty’ in *World Development*, Vol. 33(6): 893-906.
- Cutter, S. L., B. J. Boruff, Shirley L. (2003) ‘Social Vulnerability to Environmental Hazards’ *Social Science Quarterly* 84(2): 242-261.

- Dasgupta, P. (1997) 'Nutritional status, the capacity for work, and poverty traps' *Journal of Econometrics* 77(1): 5-37.
- Demetriades, J and Esplen, E., (2009) 'The Gender Dimensions of Poverty and Climate Change' in *The Social Dimensions of Climate Change: Equity and Vulnerability in a Warming World*, New Frontiers of Social Policy, World Bank.
- Denton, F. (2002) 'Climate Change Vulnerability, Impacts, and Adaptation: Why Does Gender Matter?' in *Gender and Development*, Vol. 10, No. 2.
- Devereux, S. and Edwards, J. (2004) 'Climate Change and Food Security' in *IDS Bulletin*, 35: 22–30.
- Dreze, J. and A. Sen (1991) *Hunger and public action* Oxford University Press: UK
- Enarson, E. (2000) "Gender and Natural Disasters", IPCRR Working Paper No.1. International Labor Organization (Sept. 2000).
- Ellis, F. and H.A. Freeman, Eds. (2005) *Rural Livelihoods and Poverty Reduction Policies*, London: Routledge, 404 pp.
- Eriksen, S. H., K. Brown and (2005) 'The dynamics of vulnerability: locating coping strategies in Kenya and Tanzania' in *The Geographical Journal*, 171(4): 287-305.
- Food and Agricultural Organization (2003) '*The scourge of "hidden hunger": global dimensions of micronutrient deficiencies*', G. Kennedy, G Nantel and P Shetty Eds. FAO: Rome.
- Food and Agricultural Organization (2006) *Gender the missing component of the response to climate change*, Lambrou, Yianna and Grazia Piana, Gender and Population Division, Rome.
- Füssel, H. M. and R. J. T. Klein (2006) 'Climate change vulnerability assessments: an evolution of conceptual thinking' *Climatic Change* 75(3): 301-329.
- Fuggle, R.F. (2002) 'Lake Victoria: a case study of complex interrelationships', UNEP, 2002.
- Gabrielsson, S. (2007) 'Baseline Household Survey', Lund University Centre for Sustainability Studies, Sweden.
- Gabrielsson, S. and V. Ramasar (2012) 'Widows: agents of change in a climate of water uncertainty' *Journal of Cleaner Production*, Special Edition: Water, women, wisdom, wealth. DOI:10.1016/j.jclepro.2012.01.034
- Githeko, A. K. (2009) 'Malaria and climate change', Commonwealth Health Ministers' Update, Nairobi: Kenya.
- Government of Kenya (2010) *National Climate Change Response Strategy*, Ministry of Environment and Mineral Resources, 120 pp.
- Gunga, S. (2009) 'The politics of Widowhood and Re-Marriage among the Luo of Kenya' *Thought and Practice: A Journal of the Philosophical Association of Kenya*, Vol.1 No.1, June 2009, 161-174.
- Hinkel, J. (2011) 'Indicators of vulnerability and adaptive capacity: Towards a clarification of the science-policy interface' *Global Environmental Outlook*, Volume 21, Issue 1, February 2011, 198-208.

- Hutchinson, C.F. (1998) 'Social science and remote sensing in famine early warning' *People and Pixels: Linking Remote Sensing and Social Science*. Liverman, Moran, Rindfuss and Stern Eds. National Academy Press.
- International Lake Environment Committee (2005) 'Managing Lakes and Their Basins for Sustainable Use - A Report for Lake Basin Managers and Stakeholders', ILEC, Kusatsu.
- International Fund for Agricultural Development (2011) *New realities, new challenges: new opportunities for tomorrow's generation*, Rural Poverty Report 2011, IFAD, Rome.
- Ingram, J., Ericksen, P. and D. Liverman Eds. (2010) *Food Security and Global Environmental Change*, Earthscan, London.
- Ionescu, C., Klein, R.J.T., Hinkel, J., Kavi Kumar, K.S. and R. Klein (2009) 'Towards a Formal Framework of Vulnerability to Climate Change' in *Environmental Modeling and Assessment* Volume 14, Number 1, 1-16.
- Kasperson, J.X., Kasperson, R.E., (2001) *Global Environmental Risk*, United Nations University Press, Tokyo.
- Kizza, M., A. Rodhe, et al. (2009) 'Temporal rainfall variability in the Lake Victoria Basin in East Africa during the twentieth century' *Theoretical and Applied Climatology*, 98(1), 119-135.
- Masika, R., ed., (2002) '*Gender and Climate Change*', Focus on Gender, Oxfam, Oxford.
- McCarthy, J.J., Canziani, O.F., Leary, N.A., Dokken, D.J., White, K.S. Eds., (2001) *Climate Change 2001: Impacts, Adaptation and Vulnerability*. Cambridge University Press, Cambridge.
- McHugh, M.J. (2006) 'Impact of south pacific circulation variability on East African rainfall' *International Journal of Climatology*, 26: 505-521.
- Miles, C. (2007) "Because women are property": Issues of Gender, Food Security, Property Ownership, Quasi-Development and Religion in Sub-Saharan Africa' UNU-WIDER Conference on Gender and Food Security, May 2007, Accra, Ghana
- Minot, N. (2010) 'Summary report' COMESA Policy Seminar on Variation in staple food prices: Causes, consequence, and policy options, Maputo, Mozambique, 25-26 January 2010. IFPRI: Washington.
- Misselhorn, A. A. (2004) 'What drives food insecurity in Southern Africa? A meta-analysis of household economy studies' in *Global Environmental Change*, No. 15, 33-43.
- Morton, J. F. (2007) 'The impact of climate change on smallholder and subsistence agriculture' in *PNAS* 104, 50, 19680-85.
- Moser, C. O. N. (1998) 'The asset vulnerability framework: reassessing urban poverty reduction strategies' in *World Development*, 26(1): 1-19.
- Ngombalu, J.K. (2011) '*Implication of EAC member states budgets 2011/2012 on the Grain Sub-Sector*', Easter African Grain Council, June 2011, Nairobi: Kenya.

- O'Brien, K., Eriksen, S., Nygaard, L. P. and Schjolden, A. (2007) 'Why different interpretations of vulnerability matter in climate change discourses' in *Climate policy* 7(1): 73-88.
- Odada, E. O., W. O. Ochola (2009) 'Drivers of ecosystem change and their impacts on human well-being in Lake Victoria basin' in *African Journal of Ecology*, 47: 46-54.
- Ogallo, L.A. (1997) 'Validity of the ENSO-related impacts in eastern and southern Africa' in *International Journal of African Studies*, 2 (March).
- Olago, D., M. Marshall, et al. (2007) 'Climatic, socio-economic, and health factors affecting human vulnerability to cholera in the Lake Victoria basin, East Africa' in *Ambio* 36(4): 350-358.
- Okuro, S.O., (2008) 'Struggling with inlaws and corruption in Kombewa Division, Kenya' in *Women's Land Rights and Privatization in Eastern Africa*, Englert, B. and Daley B. Eds. James Currey, Fountain Publishers, EAEP, E&D Vision Publishing, UK.
- Paavola, J. (2008) 'Livelihoods, vulnerability and adaptation to climate change in Morogoro, Tanzania' *Environmental Science & Policy* 11(7): 642-654.
- Patt, A. G., Schröter, D., Klein, R.J.T. and A.C. de la Vega-Leinert Eds. (2009) *Assessing Vulnerability to Global Environmental Change - Making Research Useful for Adaptation Decision Making and Policy*, Earthscan: London.
- Polsky, C., R. Neff and B. Yarnal (2007) 'Building comparable global change vulnerability assessments: the vulnerability scoping diagram' *Global Environmental Change* 17(3-4): 472-485.
- Preston, B., E. Yuen, and M. Westaway (2011) 'Putting vulnerability to climate change on the map: a review of approaches, benefits, and risks', *Sustainability Science* 6(2): 177-202.
- Pretty, J., Toulmin, C., and S. Williams (2011) Sustainable Intensification in African Agriculture, *Journal of international Agricultural Sustainability*. 9 (1), 5-24.
- Ragin, C. and L. Amoroso (2011) *Constructing Social Research: The Unity and Diversity of Method*, 2nd Edition, Pine Forge Press, CA: USA.
- Ribot, J.C., Magalhaes, A. and Panagides, S. eds. (1996) *Climate Variability, Climate Change, and Social Vulnerability in the Semi-Arid Tropics*, Cambridge, Cambridge University Press.
- Rosenzweig, C., Iglesias, A., Yang, X., Epstein, P., Chivian, E. (2001) 'Climate change and extreme weather events: implications for food production, plant diseases, and pests' in *Global Change & Human Health* 2, 90-104.
- Schröter, D., C. Polsky and A. Patt (2005) 'Assessing vulnerabilities to the effects of global change: an eight step approach' in *Mitigation and Adaptation Strategies for Global Change* 10(4): 573-595.
- Scoones, I. (1998) *Sustainable rural livelihoods: a framework for analysis*, IDS, Brighton: UK.
- Scoones, I. and Thompson, J. Eds. (2009) *Farmer first revisited: innovation for agricultural research and development*. Practical Action Publishing, Rugby
- Sen, A. (1999) *Commodities and capabilities*, Oxford University Press: UK.

- Smit, B., Pilifosova, O., (2003) 'From adaptation to adaptive capacity and vulnerability reduction' *Climate Change, Adaptive Capacity and Development*, Smith, J.B., Klein, R.J.T., Huq, S. Eds., Imperial College Press, London.
- Smucker, T.A. and B. Wisner (2008) *Changing household responses to drought in Tharaka, Kenya: vulnerability, persistence and challenge*, ODI, Blackwell Publishing.
- Slegers, M.F.W., Stroosnijder, L. (2008) 'Beyond the desertification narrative: an agricultural drought framework for semi-arid East Africa', *Ambio*, 37(5).
- Swallow, B. M., J. K. Sang, et al. (2009) 'Tradeoffs, synergies and traps among ecosystem services in the Lake Victoria basin of East Africa' *Environmental Science & Policy* 12(4): 504-519.
- Thompson, J. and I. Scoones (2009) 'Addressing the dynamics of agri-food systems: an emerging agenda for social science research', *Environmental Science & Policy* 12 (4).
- Thornton, P. K. et al, (2010) 'Adapting to climate change: Agricultural system and household impacts in East Africa', *Agricultural Systems*, 103, 73–82
- Traerup, S. L. M. and O. Mertz (2011) 'Rainfall variability and household coping strategies in northern Tanzania: a motivation for district-level strategies' *Regional Environmental Change* 11(3): 471-481
- Turner B L, Kasperson R E, Matson P A, McCarthy J, Corell R W, Christensen L, Eckley N, Kasperson J X, Luers A, Martello M L, Polsky C, Pulsipher A and Schiller A. (2003) 'A framework for vulnerability analysis in sustainability science', *PNAS* 100 8074–9.
- United Nations Environment Program (2006) *Environment for development: an ecosystems assessment of Lake Victoria basin environmental and socio-economic status, trends and human vulnerabilities*. Odada, E., Olago, D. and W Ochola eds., Nairobi: Kenya.
- United Republic of Tanzania (2007) *National Adaptation Program of Action (NAPA)*, Division of Environment, 52 pp.
- Watts, M. J. and H. G. Bohle (1993) 'The space of vulnerability: the causal structure of hunger and famine' in *Progress in human geography* 17(1): 43-67.
- Wandiga S. Ed. (2006) 'Climate Change Induced Vulnerability to Malaria and Cholera in the Lake Victoria Region - A Final Report' Assessments of Impacts and Adaptations to Climate Change Project, The International START Secretariat, Washington, DC: USA.
- Wisner B. and H.R. Luce (1993) 'Disaster vulnerability: scale, power and daily life' in *GeoJournal* 30(2):127–140.
- World Bank (2008) *Agriculture for Development*, World Development Report 2008, WB, Washington, D.C.
- Yohe, G. and R. Tol (2002)'Indicators for social and economic coping capacity-moving toward a working definition of adaptive capacity' in *Global Environmental Change*, 12, 25–40.



‘Because of poverty, we had to come together’: collective action for improved food security in rural Kenya and Uganda

Elina Andersson[†] and Sara Gabriellsson^{*†}

Centre for Sustainability Studies (LUCSUS), Lund University, PO Box 170, Lund SE-221 00, Sweden

Agricultural productivity in East African smallholder systems is notoriously low and food production faces multiple challenges, including soil degradation, decreasing land availability, poor market integration, disease burdens and climate change impacts. However, recent evidence from an in-depth study from two sites in Kenya and Uganda shows signs of new social dynamics as a response to these multiple stressors. This paper focuses on the emergence of local social institutions for collective action, in which particularly women farmers organize themselves. Although previous research on collective action has largely focused on common-pool resource management, we argue that collective action is one potential pathway to livelihood and sustainability improvements also in a setting of private land ownership. Trust building, awareness raising and actions to improve livelihood security through risk sharing and pooling of labour and other limited assets have given people more time and resources available for diversification, preventative activities, experimentation and resource conservation. It thereby strengthens farmers’ capacity to cope with and adapt to change, as well as contributes to the agency at the local level.

Keywords: collective action; communities of practice; food security; Kenya; smallholder farming; Uganda

Introduction

In April 2011, the Office of the Prime Minister of Uganda sent out a text message to mobile phone users in the country. It stated that ‘[a] long dry season has been predicted. Expect shortages of food, water and pasture. Store food and water to avoid hunger’. In Kenya, earlier in the year, newspaper headlines declared that, due to drought, hunger was looming and at least 150,000 people in the northern region were at risk of starving if no emergency food aid was distributed (Daily Nation 2011). Impacts of the mounting food crises in terms of livestock sale prices plummeting, cereal prices surging, water-related diseases multiplying and school enrollment delayed were also reported (The Standard 2011a, 2011b).

Unfortunately, these are not isolated cases of food insecurity in sub-Saharan Africa which not in the least has been demonstrated by the crisis that recently hit the Horn of Africa. Even prior to this, FAO (2010) estimated that as many as 239 million people, predominantly living in rural areas and relying on rain-fed agriculture, are undernourished in sub-Saharan Africa. The failure of

*Corresponding author. Email: Sara.Gabriellsson@lucsus.lu.se

[†]The authors contributed equally to the manuscript.

earlier solutions to the problem of food insecurity in the 1970s and 1980s was largely attributed to their technological and economic growth bias, stressing the significance of intensification of production and the sale of surpluses rather than equitable distribution, access, affordability and utilization. Since then, it has become clearer that food security is a highly complex issue, encompassing a wide range of interrelated environmental, social, economic and political factors at various levels (Vogel and Smith 2002, Clover 2003, Misselhorn 2005, Acevedo 2011). Because of the complexity, understanding and addressing food security requires an integrated approach, emphasizing not only the ecological challenges of food production, but also the socio-economic aspects (Thompson and Scoones 2009).

In a smallholder farming context, farmers are directly dependent on the local natural resource base and food security is closely connected to natural resource management. In order to better understand the underlying conditions that shape management decisions and use patterns, it is crucial to examine the social structures in which such resources are utilized (Agrawal 2003, Fairhead and Leach 2005). In this paper, we identify aspects of social organization and practices related to sustainable agricultural intensification and improved food security among smallholder farmers. By sustainable intensification we mean increased production on the existing land while fundamental elements and processes of the agro-ecological system are reproduced and regenerated (Alrøe *et al.* 2006, Pretty *et al.* 2011).

Drawing on research from two sites in western Kenya and eastern Uganda, we explore how locally organized farmer groups engage in collective activities to secure livelihoods. We introduce the concept of 'communities of practice' (Wenger 1998) as a way to frame and conceptualize collective action, as well as to structure and analyse our empirical material. We first illustrate the key functions and processes involved in this type of collective action, focusing on three main dimensions: joint enterprise, mutual engagement and shared repertoire. Based on this analysis, we then identify four components of co-operation, enabled by these dimensions, which translate into a multitude of actual practices. Our research suggests that this form of collective action strengthens both individual and collective incentives and capacities to invest in food production and natural resource management. It thereby serves as one potential pathway to improve livelihood security.

Reframing collective action in a food security context

In the last decade, collective action in the context of rural livelihoods has received considerable attention among scholars studying the interactions between society and the environment. Case studies are abundant, including from Kenya and Uganda (Thomas-Slayter and Rocheleau 1995, Kariuki and Place 2005, Davis and Negash 2007, Di Gregorio *et al.* 2008, German *et al.* 2008, Kaganzi *et al.* 2009, Nelson *et al.* 2010).

While much research on collective action in relation to natural resource management has focused on common-pool resources, for example forests, grazing land and water (Agrawal 2003), our intention is to explore these interactions in a private property context. In the case study areas, interviews with community members indicate that land previously used for common pasture and forestry has been transformed almost exclusively into privately owned farming land as a result of increasing population densities and land use pressure.

Literature on collective action is largely centered on the concept of 'social capital' referring to social networks, norms and trust. The concept emerged within various debates in sociology, political science and economic history (e.g. Bourdieu 1985, Coleman 1988, Putnam 1993, Fukuyama 1995) and was later also introduced into studies relating to natural resources management and development (e.g. Ostrom 1990, Moser 1998, Dasgupta and Serageldin 2000, Pretty and Ward 2001, Meinzen-Dick *et al.* 2004). The concept has been further popularized and definitions are numerous. It has also been met with much criticism, especially in the development studies

literature. Some argue that the concept is too general and can be applied to all dimensions of social life (Fine 2010, Woolcock 2010). Others point to the problems of finding adequate indicators to operationalize it in empirical research (Meinzen-Dick *et al.* 2004, Jones and Woolcock 2010). Various scholars furthermore argue that the evolution of the concept since Bourdieu has become largely divorced from its socio-political foundations, and that the analysis therefore generally lacks attention to power issues (Bebbington 2007, Knorringa and Staveren 2007). Yet, the concept of social capital has contributed to a reorientation of research and policy and to an increasing inclusion of social relations, which is a necessary component in a food security context where technological and market aspects of food production have long been central (Thompson and Scoones 2009).

For the purpose of our research, however, we conceptualize collective action and its social and cultural context by drawing on the concept of ‘communities of practice’ (Wenger 1998). It offers a way of reframing collective action within more clearly defined boundaries, which also facilitates its application in empirical research. Centered on notions of shared meaning, identity and social learning, we argue that it provides a framework for dealing with not only how people respond to and cope with change, but also how they *shape* change through collective organization.

Communities of practice are ‘groups of people who share a concern, a set of problems or a passion about a topic, and who deepen their knowledge and expertise in this area by interaction on an ongoing basis’ (Wenger *et al.* 2002, p. 4). Social learning is at the core of this process, although it is often an unintentional outcome that occurs when people with a common interest come together to share ideas, develop strategies, find solutions and build innovations. Communities of practice are ubiquitous in everyday life and all people belong to various, overlapping communities of practice; they can be a team of scientists, a youth group in a sub-culture, a sewing circle or an online community (Wenger 1998). Although the concept of communities of practice has received much interest in the social sciences, its application has thus far been limited in the field of agricultural and rural development research.¹

Following Wenger (1998), we identify a community of practice as comprising three deeply interconnected and mutually defining dimensions: *joint enterprise*, *mutual engagement* and *shared repertoire* (Figure 1).

The *joint enterprise* keeps a community of practice together and is the result of a collective process of negotiation. Through participation based on shared interests and concerns, members build collaborative relationships and establish common goals and visions, even though individual situations and motivations for participation may differ. *Mutual engagement* is the basis of membership in a community of practice. Through their interactions, participants build trust and create shared norms about contribution and commitment, which bind them together and give rise to reciprocity among members. This creates a common ground for handling tensions and disagreements

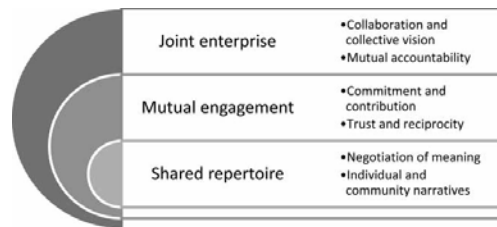


Figure 1. Dimensions of communities of practice (adapted from Wenger 1998).

and is thus a source of group sustenance. The development of a *shared repertoire* is the result of mutual engagement in a joint enterprise. It includes routines and rituals, stories, symbols and actions that become part of the group's practice. This forms the basis for members' building of identities and narratives, both at individual and community levels, which provide additional meaning to their actions (Wenger 1998).

By using the concept of communities of practice, we can explore the social and cultural context in which collective action takes place. While much of the existing literature on collective action in natural resource management has mainly concentrated on decision-making processes, rules and sanctions that govern resource use and access within a social capital framework (Clever 2007), we seek to depict the mechanisms of social cohesion by which groups for collective action are formed, sustained and developed over time. In other words, while the groups in this study are no different from community-based groups involved in collective action studied elsewhere, we argue that this framework provides new insights to interpret and illustrate group activities, and their linkages to sustainable agricultural practices.

An emphasis on social cohesion may mask the fact that these communities of practice might also function coercively, exclude people from participation and reinforce existing inequalities within a community since various subjects have different interests, influences and capacities in relation to collective action. Gender is, for instance, an important source of power differentials (Mayoux 2001, Agrawal 2003, Ballet *et al.* 2007, Pandolfelli *et al.* 2008, Quisumbing *et al.* 2011). However, even though the concept does not explicitly deal with power, it offers a framework for exploring mechanisms of exclusions and what is often referred to as 'the dark side' of social capital (Ballet *et al.* 2007). These are indeed key issues for further research, but not the focus of this paper.

Research methods and study settings

This paper draws on individual research in Nyando district in western Kenya and Tororo district in eastern Uganda, respectively (see Figure 2). The projects target rural small-scale agricultural communities but have different foci: adaptive capacities to climate vulnerability and local strategies to



Figure 2. Map of location of case study areas in Kenya and Uganda.

improve soil fertility, respectively. Both have linkages to food security, collective action and agricultural sustainability. The projects are framed in relation to an interpretative research epistemology (Mikkelsen 2005), which implies that we take our departure point in the knowledge and experience of local farmers to induce and generate conceptual tools that are used to interpret and structure the empirical data in an iterative process (Bryman 2008).

Empirical data for this paper were collected in the two study areas during several fieldwork periods between 2008 and 2011. The research methods were mainly qualitative, with the objective of understanding and explaining reasons for and the dynamics of phenomena rather than measuring or quantifying the existence of such phenomena (Flick 2006). A combination of household and group interviews, participatory mapping and ranking exercises, and narrative walks allowed for data triangulation (Bryman 2008). In both cases a baseline household survey was carried out, including 100 households, respectively.

Periodic group interviews with 10 farmer groups were carried out over 4 years in both study areas and forms the basis of the empirical data that this paper draws upon. Selection of groups was done together with local key informants and based on purposive sampling (Bryman 2008). Criteria for selection included groups that had been active for more than a year, involved in multiple activities relevant for sustainable agriculture, locally formed, self-organized and consisting solely of community members, and receiving no external funding. Group interviews centred on group functions and organizational structure, internal social dynamics, benefits and drawbacks associated with collective engagement, relations to actors within and outside the local community, ongoing activities and impacts on food and livelihood security.

For this in-depth study, collected data were analysed using thematic analysis, whereby searching for and clustering recurring themes in our group interview transcripts. Rather than carrying out a comparative analysis of the two study sites, our intention in this paper was to identify commonalities and differences across groups. Common themes include farmers' experience of change related to natural conditions, food security situation, collective action over time, as well as agricultural practices.

The study areas are characterized by mixed agricultural livelihoods based on small-scale farming and livestock keeping. Crops commonly grown by farmers include maize, cassava, millet, cow peas and various vegetables. Farmers also keep poultry, goats, cattle and some dairy cows. Plot sizes are generally small and crop yields are typically well below potential yields found at research stations. Gender inequalities in access to land, as well as other productive resources, including finances remain significant. Key features of the livelihood and food security situation in the case study areas are described in Table 1.

Changing realities

Multiple stressors and implication for food security

The soil is worn out – Nyachwo, Tororo

The rains are very unpredictable – Rose, Nyando

As indicated by the above testimonies, farmers in the case study areas are experiencing that their livelihood conditions are becoming increasingly difficult as a result of multiple stressors. These include changing rainfall patterns, soil fertility decline and erosion, land pressure, decreasing water stocks, hunger and malnutrition and growing disease burdens. The trends were recorded independently in both study sites. Long-term negative crop production trends are one of the most obvious and important indicators of deteriorating livelihood conditions. For instance, storage of crop surpluses is no longer an accessible security measure to the majority of households in the

Table 1. Features of the case study areas.

	Population density (persons/km ²)	Average household size*	Median land size (acres/household)*	Percentage of population below poverty line [†]
Nyando district, Kenya	285	6.5	1.5	61*
Tororo district, Uganda	330	4.8	2.5	48

* Refers to household survey conducted by the authors in respective case study area.

[†] Based on the expenditure that allows a minimal nutritional requirement to be met.

Sources: UBS (2002), CBS (2003), Odada *et al.* (2006).

study areas. This corresponds to similar findings across sub-Saharan Africa (Sanchez 2002, Odada *et al.* 2006, Pender *et al.* 2006, Toulmin 2009, Rarieya and Fortun 2010).

Of the multiple stressors, farmers repeatedly identified two key environmental factors as constraining their food production: erratic rainfall and land degradation. Both have far-reaching implications on all aspects of the agri-food system. The distribution of rainfall both in time and geographic scope has become increasingly unpredictable. This has large impacts on food security since these regions largely depend on rain-fed agriculture. The implications are well known by those living in the area: depleted water sources, poor harvests, livestock number reductions and loss of wild plants for gathering (see also Ziervogel *et al.* 2006, Gabrielsson *et al.* 2010). Climate research also indicates that increasingly erratic rainfall is predicted for the area (Hulme *et al.* 2001, Thornton *et al.* 2010).

Land degradation, primarily in the form of soil fertility decline and soil erosion, is another key factor identified by farmers as contributing to food insecurity in the region (see also Pender *et al.* 2006, Nkonya *et al.* 2008). It leads to declining yields, low crop quality and increased vulnerability to pest and disease infestations. While the causes of land degradation are highly complex, involving not only bio-physical but also socio-political dimensions (Andersson *et al.* 2011), the result is that farming systems have not been able to maintain their long-term productive capacity.

The consequence of these changes is that farmers now have to utilize their existing, and already limited, resources more intensively, especially land and labour. Moreover, because of the complexity of the problems, working the land entails more risk and unpredictability, including the ability to optimize yields and market prices through timely planting, harvesting and labour inputs. In order to respond to these changes, many see a greater need for organizing collectively as a strategy to improve food security. Hence, new social institutions for collective action at local levels have emerged over the last decade.

Collective action in the past and present

There were no groups here in the past, they [farmers] never realized the benefits from being in groups before and that is why they never existed before – Katito Conservation Group, Nyando

[In] those days, activities would just end in themselves. Now, we meet new people and get new ideas; one activity develops into another – Dhire Chegin, Tororo

Collective action is not a new phenomenon in this region. However, as indicated by the quotes above, its organization is now significantly different from before. During the past decade, the creation of local groups and the diversification of their activities have intensified. Traditionally,

collective action activities mainly revolved around the immediate neighbourhood and focused on pooling of labour for specific tasks during intensive periods in the agricultural cycle, such as land preparation, harvesting and grinding. In addition, collective action also involved financial and food support as an emergency response to individual households in need. Such activities were short term and ended when tasks were completed. They generally required payment in the form of animal slaughter, beer brewing and communal meals.

In contrast, present collective action taking place among communities of practice evolve more organically and is the result of an agreed upon long-term collective vision. In the study areas, both the number of groups and the level of structure of their activities have increased during the last decade. This can be attributed to a combination of the aforementioned multiple stressors, and an increased focus on participation and community engagement in current development policy and practice (Chambers 2007, Scoones and Thompson 2009).

The groups interviewed have existed for an average of six years and generally include 25–35 members. Women are in the majority, although all groups also include male members. Most groups are registered nationally, which makes them eligible to apply for outside funding, and more likely to access agricultural extension services provided by governments and non-governmental organizations. The groups generally have rigorous organizational structures where meeting procedures, roles, duties and membership responsibilities are well defined and documented.

Communities of practice at work in Nyando and Tororo districts

Joint enterprise

Being in a group has advantages because you may not be able to prepare your *shamba* [garden] and your land yourself. If you are in a group, other members can come and help you because they know your challenges, so there are benefits from that – Katito Conservation Group, Nyando

The foundation of a community of practice, in this setting, is a joint enterprise, that is, committed people coming together as a response to their circumstances and finding ways to respond to changing livelihood conditions. Hence, members assert that the common purpose of these groups is focused on ensuring livelihood security, primarily through increased food production. This is achieved by engaging collectively in improving natural resource management, diversifying income opportunities or merely pooling labour for strenuous activities such as land preparation, weeding and crop harvesting. However, their enterprise is not just centered on farming as such, but is defined by participants through their mutual engagement, and is thus much more complex; it also includes giving each other daily support, sharing difficulties and joy, being proud of their endeavours and sharing the experience of livelihood uncertainties.

According to the groups, one reason for their continued progress in terms of activities and entrepreneurship is a shared vision of the future, which is about securing a livelihood not only for themselves and their immediate family but also for the subsequent generation. A common reason and motivation for forming and joining groups is, for instance, that the joint activities and saving systems have made it possible for many members to pay school fees for their children, including girls. Moreover, the fact that farming land has become a pressing constraint has, in combination with other stressors, created incentives for improving farming practices in order to improve productivity and the long-term capacity of land.

An important difference with self-organized communities of practice described in this study compared to other community-based organizations initiated by outside actors is that the enterprise is ultimately defined by the community itself. This is a constant process, which creates a sense of ownership, as it belongs to the members in a profound sense (Wenger 1998).

We like to work together, because we own it; it is ours and we are a part of it – Katito Conservation Group, Nyando

The majority of the groups included in this study have formed independently, without the influence of outside actors such as non-governmental organizations and government directives or policies. Still, initiation of the groups has often been motivated by, and in some sense facilitated by, inspiring leaders or group endeavours in other geographic locations, serving as examples of readiness to adapt to changing conditions and influencing attitudes to the way farming activities can be organized and performed.

Mutual engagement

We do not listen to the voices of other people anymore. Only those that we can trust we have around us. In the group we know each other so well and there is nothing we cannot talk about with one another – Kobongo Farmer's Group, Nyando

Whenever something bad happens to one of us we feel touched all of us and we will chip in in any way we can – Katito Conservation Group, Nyando

They [groups today] are formed due to poverty, to create unity among ourselves – Were Nyalo, Tororo

Mutual engagement is the basis of developing strong relations between people, which in turn is necessary for the function of the joint enterprise. Without trust and reciprocity between members, there cannot be commitment and contribution towards the common goal that the groups set up. As indicated by the statements above, the groups show evidence of this mutual engagement through the trust they feel for each other, contributions they are making to the group and the willingness they have to assist each other in times of need. Although shared experience is the basis for the creation of such mutual relations of engagement, also diversity among participants in terms of capabilities and personalities is often crucial for a community of practice to be productive (Wenger 1998). Some of the groups that in the past consisted only of women have realized that they must also involve men because of their greater mobility and access to wider social networks and information sources. Subsequently, many of the groups now include both female and male members. However, group compositions and interviews with members show that men generally are more reluctant to initiate and join groups, which in most cases are dominated by female members.

The communities of practice can be described as multi-task groups where activities include experimentation with and adaptation of various agricultural technologies. A prerequisite for this to function is that all members contribute to the group work regularly. Contributions come both in the form of time (farm labour, caring for children and sick members), money (group savings and loans) and resources (land and other productive resources) as well as in sharing equipment and tools. These contributions vary according to the means of individual members, indicating that members do acknowledge peoples' varying livelihood conditions. This illustrates norms of reciprocity and trust that exist among group members, which also is demonstrated by the differentiated responsibilities assigned to members. Both contributions and commitment to shared goals are changing constantly and are re-negotiated within the groups. This reflects the central role of members' agency and ownership in collective efforts. In summary, the way in which these groups are structured is an example of organizational flexibility. Given the hardships and unpredictability faced by people in their daily lives, the collective commitments create stability and open new opportunities for mobilizing action that contributes to long-term change.

Shared repertoire

We now look upon ourselves as children of the same person, of the same house – Katito Conservation Group, Nyando

As a result of mutual engagement in a common enterprise, communities of practice develop a shared repertoire. This is ‘the source of community coherence’ (Wenger 1998, p. 82), and includes routines, symbols and social interactions within a group. This shared repertoire forms the basis for constant negotiation of meaning within the community of practice. It allows this for stable and long-term, yet dynamic, relations between members. As pointed out by Anyidoho (2010), meaning is often shaped through stories and narratives. Such narratives are not only individual, but are also formed at the community level. The two are inter-related and mutually reinforcing as they shape and provide meaning for each other. The community narrative is a source of identity and works as the glue that binds individuals together, and can thus be seen as a ‘key element in both individual and social change’ (Anyidoho 2010).

One source of collective identity and shaping of community narratives is the way group members construct ideas about themselves as open, creative and innovative persons in the forefront of change-making. This stands in contrast to how they imagine non-member farmers in the wider community and community members in the past. The farmers explain this by saying that:

Some people still want to do life as in the old days – Silwany Kirom, Tororo

They [people in the past] didn’t have the ideas – Marok Ber, Tororo

There were about 60 people in this group at the beginning here and now half has dropped out. So there were only a few that insisted on working up until the end. It was a general vision that they had. And persistence. – Katito Conservation Group, Nyando

Collective identity is also shaped and expressed by various rituals and symbolic actions. This includes, for instance, singing and dancing in meetings and routines around the collection of members’ weekly contributions to the collective fund. Social learning resulting from shared experiences among group members of both failure and success is another source of collective identity and meaning.

By seeing [what the group is doing], many people can change – Were Nyalo, Tororo

It is not difficult to inspire [people outside the group], as they see how the group performs – Were Nyalo, Tororo

Our group is now known in various places – Silwany Kirom, Tororo

Other groups are trying to emulate the work we do here – Kobongo Farmers’ Group, Nyando

Some people come for advice [on farming] to the group. We want to change attitudes and old habits in our community. Cause some people [like ourselves] just have a love for it – Ngiyo Ber Nyawimbi Women’s Group, Tororo

The way group members explain how the endeavours pursued by the group have contributed to a sense of self-esteem and pride, as well as given them recognition and respect in the local area, illustrates how collective narratives are shaped within communities of practice. This has in many cases contributed to the creation of agency and voice in both

‘private’ and community matters. As expressed in the flowing quotes, it is thus a key element in social change.

When I buy something for the home, my husband doesn’t come and ask in a rude way, ‘cause he knows I too have money, my own – Ngiyober Nyawimbi Women’s Group, Tororo

When we go for meetings and go back late, the husband won’t ask cause he knows we have done something good – Ongonye Arom, Tororo

Women in particular describe how their engagement in groups has contributed to strengthen their bargaining power within the household, both regarding financial decision-making and the structuring of daily activities. Although gendered norms regarding division of labour and responsibilities largely remain, as women still carry the heaviest burdens of production and reproduction, this is an example of how social change can emerge from collective action.

It is important, however, to realize the limitations of collective action at the local level as a source of social change; many of the problems facing the rural poor are structural and require different types of measures. Moreover, while collective action might be particularly relevant for women and other marginalized groups, existing power structures and differences in access to various assets can reduce the group’s ability to participate in, and benefit from, collective action (Ballet *et al.* 2007, Pandolfelli *et al.* 2008).

The significance of collective action for improved food security

The low priority generally given to the agricultural sector in sub-Saharan Africa during the last few decades by both national governments and international donors have resulted in low and declining per capita food production and poor conditions in rural areas (IFAD 2010, Pretty *et al.* 2011). In combination with increasing population densities, land availability has become a constraint in the study areas. The land use pressure has resulted in smaller and fragmented plots. For agriculture to play its part in rural development and poverty alleviation, sustainable intensification of agriculture on existing land is therefore imperative. Improvements of rural conditions generally involve structural change and require targeted investment, improved market conditions and enabling policy frameworks. Yet, a better understanding of how development can be stimulated at the local level is valuable.



Figure 3. The four facets of food security (adapted from FAO 2000).

Food security can only be realized when all its four facets are met: availability of food, stability of food supply, access to food and utilization of food (Figure 3; FAO 2000). Whereas food availability and stability refer to an existing and continuous flow of food stocks for consumption, household food access refers to the ability to acquire both sufficient quality and adequate quantities of food to meet all household members' nutritional requirements. Subsequently, access to food is determined by physical and financial resources, as well as by social and political factors. Utilization of food depends on how food is used, whether it possesses sufficient nutrients and if a balanced diet can be maintained (Ziervogel *et al.* 2006).

Components of cooperation to intensify local food production

Based on farmer group interviews and participant observation of group functions and activities performed, we have identified four key components of cooperation that are relevant for sustainable intensification of food production. All communities of practice involved in the study employ these components in various degrees and manners. Although the components are not new, it is their representation in all the groups that makes them noteworthy. The four components are inter-related and include:

- (1) pooling of resources;
- (2) group savings and loans;
- (3) platform for internal knowledge production; and
- (4) networking and knowledge exchange between groups and outside actors

Pooling of resources entails not merely sharing seeds and tools among group members but also involves schemes for labour pooling, as well specific plots procured and cultivated jointly by the group. Pooling of labour is organized in such a way that all members work on each other's individual plots on a reciprocal basis. The seasonal farming cycle determines the amount and intensity of the work. Since labour generally is a key-limiting factor in agricultural production in the study areas, collective labour is tremendously important. First, it allows for better timing of laborious agricultural tasks, which is essential for crop performance. Second, since a large share of the farmers previously spent significant amounts of their income for hiring outside labour to perform such tasks, financial resources can be allocated for other productive purposes. This recurrent theme indicates that more resources now can be devoted to crop diversification, education and human and animal health care. Thirdly, labour pooling also facilitates a wider uptake of labour-demanding land management practices, such as building soil and water conservation structures, therefore enhancing the long-term productive capacity of land. There are also examples of how labour pooling by groups enables investment in collectively used resources, such as construction of water ponds for irrigation and fish farming, as well as drainage of wetlands for cultivation.

An additional aspect of resource pooling is the plots that the majority of groups cultivates and manages collectively, which according to responses is a relatively new phenomenon in the study areas. Group plots play an important function in facilitating technology experimentation and adaptation, particularly since individual members' plots generally are so small that trying out new practices and crop varieties is often perceived as risky. Since non-member farmers can also observe these plots, benefits of the collective knowledge production are not restricted to group members. Moreover, for several of the groups, jointly managed plots offer a space for activities such as collective manure production, tree nurseries and rainwater harvesting.

The second component of cooperation relates to the savings and credit systems that all the communities of practice in this study are engaged in. The systems are organized in various

ways, but in general, members make monetary contributions to a collective fund on a weekly basis (US\$0.5–3.5). Members can access loans from the fund at low interest rates and collective savings are distributed among members yearly. Funds are also used for collective purposes related to food production, and for off-farm income diversification. The savings and credit systems allow individual households to plan ahead and budget for health checkups, medication, school fees and veterinary services. In addition, the savings can act as an emergency fund, thus avoiding resource diversion in terms of food and household assets sales, which previously has been the only available coping strategy during times of hardship.

The third key component of cooperation is the platform for knowledge exchange and production that communities of practice provide. This space enables members to share information and experiences on different agricultural practices, and to collectively produce knowledge through technology experimentation and innovation. It furthermore facilitates sharing of price and market information, thus enhancing farmers’ abilities to negotiate better prices for their commodities.

Collective action also enables networking between active groups within a community and with external actors, which is the fourth component of cooperation. Field visits and group-to-group training sessions on various farming techniques and natural resource management practices are, for instance, conducted in the study areas. Moreover, farmer groups also invite schools and non-member farmers to their plots for educational purposes, thereby playing an important role in the diffusion of best practices. This potentially strengthens the status of farming and boosts confidence among group members from being recognized. Lastly, farmer group membership is often a gateway to agricultural extension services and is generally a condition for being eligible for external funding and credit support, which often is crucial for the ability to invest in food production.

A multiplicity of practices and their contribution to food security

In the context described here, the four components of cooperation translate into a multiplicity of observed and documented practices, which in various ways and degrees contribute to the four facets of food security. In Figure 4, some key practices and their contributions to food security are summarized. Here, food availability and stability are predominantly tied to activities that

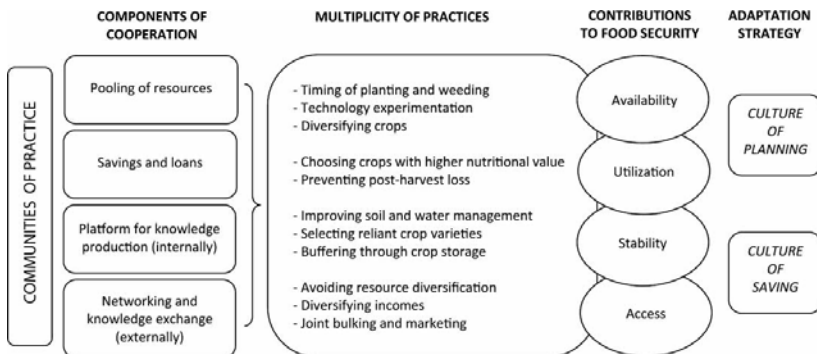


Figure 4. Cooperation components and collective practices for food security. Source: Andersson and Gabrielsson (2011).

contribute to increased yields and prevention of crop failure, while food utilization and access relate to the variety and value of food produced, consumed, bought and sold.

Examples of practices enabled by collective action that contribute to the *availability* of food include measures that improve the timing of agricultural task performance. The matching of land preparation and planting with the start of the rainy seasons, along with timely weeding, is, for instance, crucial for optimizing yields. As mentioned, labour pooling through detailed planning helps to ensure that farmer group members receive the necessary support to be able to perform tasks in a timely manner. Collective action has also stimulated the production and exchange of knowledge, which, for instance, facilitates crop diversification and selection of crop varieties that contribute to increased total production by allowing intercropping and prolonged harvest periods. Examples of productivity-enhancing experiments carried out by the communities of practice include use of urine as a fertilizer, construction of various water conservation structures and experimentation with fodder- and cover crops.

Practices contributing to improved *utilization* of food include cultivation of crops with higher nutritional value, such as vegetables, soybeans and other legumes. This is especially relevant in Kenya, where diets are largely maize based. Farmer groups provide an important avenue for knowledge exchange and awareness raising regarding selection of crops that can contribute to more balanced diets. Through field visits, group-to-group training events and networking with external actors, farmer group members in the study areas have become increasingly aware of various tree species that can be used for improving the nutritional value of animal fodder, and for producing ‘plant tea’, that is, liquid fertilizer. Moreover, collective funds are used to invest in livestock rearing, which contribute to both increased intake of animal protein and calcium through dairy production. The platform for knowledge exchange provided by communities of practice has also increased the awareness and knowledge of various post-harvest loss prevention measures, including improved crop storage. The measure also has the benefit of conserving the nutritional value of the crops stored.

Practices that contribute to greater *stability* in food production and supply include selection of more reliant varieties and combinations of crops. Increased use of drought-resistant cassava and mixed cultivation of hybrid and traditional maize varieties are examples of practices used by groups to ensure stable yields in a context of high climate variability. In many cases, the groups also provide important platforms for seed saving and exchange. Furthermore, improved soil and water management plays a crucial role in ensuring greater stability in production and the long-term capacity of land. Especially on the joint plots, farmer group members are experimenting with various soil erosion prevention measures, and water harvesting techniques. Through the groups, the diffusion of individual farmer’s innovations and experiences with various conservation measures is also facilitated. Essential for the stability of food over time is buffering through crop storage; in some cases through collective investment in storage containers.

An important function of groups in relation to food *access* is the collective funds, which are used to invest in income diversification activities such as small-scale businesses, petty trading and various value-adding activities. Examples include tree nurseries for the sale of seedlings, fruit juice manufacturing and mushroom production. Some groups have also used collective funds to buy bicycles in order to improve access to input and output markets. Through joint bulking and marketing of products, group members are able to increase profits by attaining better prices and cutting transaction costs. Collective funds also play an important role in avoiding household resource diversion during times of the year when expenditures are high and incomes low.

An emerging culture of saving and planning

Coping with drought and food shortage is not a new phenomenon for individuals, communities or nations. The difference now is that for the majority of natural resource-dependent communities, the changing realities exacerbate already dire livelihood conditions and increase their food insecurity. Part of this is explained by the sheer magnitude and complexity of the interlinked changes taking place and the probability of increased uncertainty in the future, which limit the range of strategies that communities are able to employ to avoid and prepare for the changes (Ikeme 2003).

This study has shown that some communities have taken matters into their own hands by joining forces. Through collective action such communities not only cope with the impacts of change, but also adapt to change by employing a deliberate *strategy*, where saving and planning work in tandem. Building on Swidler (1986), we here refer to 'strategy' as a constructed chain of actions, allowed or limited by the existing social and cultural context, to achieve one or several goals. In short, the integrated strategy employed by the communities of practice studied involves a multiplicity of activities performed with the general ambition of continuously improving the livelihood security of both individual members and the group as a whole. We perceive this as an *adaptation strategy* since it is a long-term response to changing realities experienced by local communities. Adaptation can be seen as a process, action or outcome in a system, for instance a household or community, that leads to ways of managing or adjusting to some changing condition, stress, risk or opportunity (Smit and Wandel 2006). There is a significant difference between merely coping with change and adapting to the same. Indeed, the two are not only distinguished by timescale but also by timing – being reactive or proactive – as well as agency, that is, whether adaptation comes autonomously or is planned (Smithers and Smit 1997, Frankhauser *et al.* 1999, Klein *et al.* 1999, Smit *et al.* 2000). In sum, a coping strategy refers to actions taking place within existing structures, whereas an adaptation strategy involves changing the framework of a system, thereby reducing the need for coping (Eriksen *et al.* 2005).

The emerging culture of saving and planning among the communities of practice in the study areas have multiple benefits for those involved. Various examples of the adaptation strategy demonstrated here indicate that farmers now have expanded the repertoire of means to react to the unpredictability of food production in East Africa. Collective organization thus fills a critical void in a context where alternative strategies, such as out-migration, dependence on remittances and transition to off-farm employment are limited, particularly for female farmers. More importantly, collective organization is a strategy that also strengthens the capacity to improve food production and security by taking advantage of knowledge, networks and resources of others. This enables farmers to seek new livelihood opportunities while reducing livelihood risks. These so-called regenerative responses (Thomas and Twyman 2005) can thus be seen as attempts by the farmers to address dynamic and longer-term issues affecting their food security situation today, as well as in the future.

Conclusions

In the context of East African smallholder farming, the lack of food security is certainly one of the most palpable dimensions of poverty. As indicated by the citation in the title of this paper (Dhire Chegin farmer group 2011), the emergence of local social institutions for collective action can be seen as a demonstration of farmers' need for new strategies to deal with changing livelihood conditions and multiple stressors. While most research on collective action has focused on common property resources, collective action is evidently relevant also in a private resource ownership context. However, since the problems of food insecurity and poor rural conditions are rooted in a multitude of underlying social, economic and political factors at various levels, the

impacts of collective action at the local level are, for instance, bound by legal rights to land, poor infrastructure and unequal market opportunities, gendered division of labour and responsibilities, political exclusion and lack of access to education, agricultural support and relevant technologies.

Moreover, existing inequalities within a community imply that all individuals do not have the same incentives and abilities to participate in and benefit from collective action. Hence, activities performed by the farmer groups described here clearly do not represent a development panacea and cannot replace governmental interventions to improve rural conditions and investments in the agricultural sector. However, this paper shows that certain types of social organization allows for cooperation that enables farmers to engage in various activities and generate new ideas that facilitate sustainable agricultural intensification to improve food security.

The concept of communities of practice offers a way to contextualize collective action in a particular setting. Centered on notions of shared meaning, identity and social learning, it deals not only with how people cope with and adapt to change, but also how they *shape* change through collective action. The concept thus helps to elucidate the social dynamics of and linkages between collective action and natural resource management and places individual strategies within a wider social context.

We argue that the way these communities of practice organize, their multi-purpose activities and the constant re-negotiation of goals imply a long-term perspective on actions and organizational structure, allowing a high degree of flexibility to respond to multiple challenges characterized by uncertainty. The ability of these communities of practice to successfully respond to multiple stressors can be explained by a combination of factors. In particular, we would like to stress the following three aspects: how they organize, how they engage in multi-purpose activities, and how they continuously (re)negotiate their long term goals. All this allows for a high degree of flexibility to respond to challenges characterized by uncertainty and it strengthens local agency to shape change. By fostering a culture of planning and saving, this type of collective action among farmers potentially enhances both the *incentives* and *motivations* to invest in food production and adopt sustainable resource management practices, and the *capacity* to implement such practices. While it may be feasible also for an individual farmer to invest in such production improvements, strategies collectively employed make such possibilities available also to resource-poor farmers, who generally lack the means to grasp such opportunities on their own.

Based on these findings, we therefore suggest that social institutions for collective action at the local level should be acknowledged by governments and the international development community for their vital role in rural agricultural development. In addition, policies are needed to support and connect these isolated islands of action to diffuse and scale-up locally proven strategies and practices.

Acknowledgements

We are grateful for the financial support of the Linnaeus Centre LUCID, funded by the Swedish Research Council Formas and of the Swedish International Development and Cooperation Agency Sida. Many thanks also to the farmer group members who participated in the research and patiently shared their knowledge and experiences.

Note

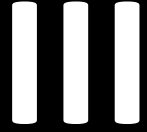
1. A study by Anyidoho (2010) is one of the few examples that we have found.

References

- Acevedo, M., 2011. Interdisciplinary progress in food production, food security and environmental research. *Environmental conservation*, 38, 151–171.
- Agrawal, A., 2003. Sustainable governance of common-pool resources: context, methods, and politics. *Annual review of anthropology*, 32, 243–262.
- Alroe, H., Byrne, J., and Glover, L., 2006. Organic agriculture and ecological justice: ethics and practice. In: H. Halberg, et al., eds. *Global development of organic agriculture: challenges and promises*. Wallingford: CAB International.
- Andersson, E. and Gabriellsson, S., 2011. The role of collective action for food security, presentation at Global Food Security Colloquium 2011, The Royal Swedish Academy of Sciences, Stockholm.
- Andersson, E., Brogaard, S., and Olsson, L., 2011. The political ecology of land degradation. *Annual review of environment and resources*, 36, 295–319.
- Anyidoho, N.A., 2010. ‘Communities of practice’: prospects for theory and action in participatory development. *Development in practice*, 20 (3), 318–328.
- Ballet, J., Sirven, N., and Requieris-Desjardins, M., 2007. Social capital and natural resource management: a critical perspective. *Journal of environment & development*, 16 (4), 355–374.
- Bebbington, A., 2007. Social capital and development studies II: can Bourdieu travel to policy? *Progress in development studies*, 7 (2), 155–62.
- Bourdieu, P., 1985. The forms of capital. In: J.G. Richardson, ed. *Handbook of theory and research for sociology of education*. New York: Greenwood.
- Bryman, A., 2008. *Social research methods*. Oxford: Oxford University Press.
- Central Bureau of Statistics, 2003. *Kenya Demographic and Health Survey 2003*. CBS, MOH and OCR Macro Calverton Maryland.
- Chambers, R., 2007. *From PRA to PLA and pluralism: practice and theory*. IDS Working Paper No. 286. Brighton: Institute of Development Studies.
- Cleaver, F., 2007. Understanding agency in collective action. *Journal of human development*, 8 (2), 223–244.
- Clover, J., 2003. Food security in sub-Saharan Africa. *African security review*, 12 (1), 5–15.
- Coleman, J.S., 1988. Social capital in the creation of human capital. *American journal of sociology*, 94, 95–121.
- Daily Nation, 2011. Hunger looms. *Daily Nation*, 10 January, p. 6.
- Dasgupta, P. and Serageldin, I., eds., 2000. *Social capital: a multi-faceted perspective*. Washington, DC: World Bank.
- Davis, K. and Negash, M., 2007. *Gender, wealth, and participation in community groups in Meru Central District, Kenya*. CAPRI (CGIAR Systemwide Program on Collective Action and Property Rights), Working Paper No. 65. Washington, DC: IFPRI.
- Dhire Chegin farmer group, 2011. Group interview by Andersson, E., 21 February 2011. Unpublished field data, Sere Parish, Tororo District.
- Di Gregorio, M., et al., 2008. *Property rights, collective action, and poverty: the role of institutions for poverty reduction*. CAPRI (CGIAR Systemwide Program on Collective Action and Property Rights), Working Paper No. 81. Washington, DC: IFPRI.
- Eriksen, S., Brown, K., and Kelly, P., 2005. The dynamics of vulnerability: locating coping strategies in Kenya and Tanzania. *The geographical journal*, 171, 287–305.
- Fairhead, J. and Leach, M., 2005. The centrality of the social in African farming. *IDS bulletin*, 36 (2), 86–90.
- FAO, 2000. *Guidelines for national FIVIMS: background and principles*. Rome: Food and Agriculture Organization.
- FAO, 2010. *The state of food insecurity in the world: addressing food insecurity in protracted crises*. Rome: Food and Agriculture Organization.
- Fine, B., 2010. *Theories of social capital: researchers behaving badly*. London, UK: Pluto Press.
- Flick, U., 2006. *An introduction to qualitative research*. London: Sage Publications Ltd.
- Frankhauser, S., Smith, J.B., and Tol, R.S.J., 1999. Weathering climate change: some simple rules to guide adaptation decisions. *Ecological economics*, 30, 67–78.
- Fukuyama, F., 1995. Social capital and the global economy. *Foreign affairs*, 74, 89–103.
- Gabriellsson, S., et al., 2010. *Seasonal pattern of climate vulnerability and adaptation in the Lake Victoria basin – identifying needs and opportunities using a multi-stakeholder approach*. Poster presented at the American Association for the Advancement of Science, Annual Conference. San Diego, USA, 18–22 February 2010.

- German, L., et al., 2008. *Enabling equitable collective action and policy change for poverty reduction and improved natural resource management in the Eastern African highlands*. CAPRI (CGIAR Systemwide Program on Collective Action and Property Rights), Working Paper No. 86. Washington, DC: IFPRI.
- Hulme, M., et al., 2001. African climate change: 1900–2100. *Climate research*, 17, 145–168.
- Ikeme, J., 2003. Equity, environmental justice and sustainability: incomplete approaches in climate change politics. *Global environmental change*, 13 (3), 195–206.
- International Fund for Agricultural Development, 2010. *Rural poverty report 2011*. Rome: IFAD.
- Jones, V.N. and Woolcock, M., 2010. Measuring the dimensions of social capital in developing countries. In: E. Tucker, M. Viswanathan and G. Walford, eds. *The handbook of measurement*. Thousands Oaks, CA: Sage.
- Kaganzi, E., et al., 2009. Sustaining linkages to high value markets through collective action in Uganda. *Food policy*, 34, 23–30.
- Kariuki, G. and Place, F., 2005. *Initiatives for rural development through collective action: the case of household participation in group activities in the highlands of Central Kenya*. CAPRI (CGIAR Systemwide Program on Collective Action and Property Rights), Working Paper No. 43. Washington, DC: IFPRI.
- Klein, R.J.T., Nicholls, R.J., and Mimura, N., 1999. Coastal adaptation to climate change: can the IPCC Technical Guidelines be applied? *Mitigation and adaptation strategies for global change*, 4, 239–252.
- Knorringa, P. and van Staveren, I., 2007. Beyond social capital: a critical approach. *Review of social economy*, 65 (1), 1–9.
- Mayoux, L., 2001. Tackling the down side: social capital, women's empowerment and micro finance in Cameroon. *Development and change*, 32, 435–464.
- Meinzen-Dick, R., DiGregorio, M., and McCarthy, N., 2004. Methods for studying collective action in rural development. *Agricultural systems*, 82, 197–214.
- Mikkelsen, B., 2005. *Methods for development work and research: a guide for practitioners*. India: Sage Publications.
- Misselhorn, A.A., 2005. What drives food insecurity in southern Africa? A meta-analysis of household economy studies. *Global environmental change*, 15 (1), 33–43.
- Moser, C., 1998. The asset vulnerability framework: reassessing urban poverty reduction strategies source. *World development*, 26 (1), 1–19.
- Nelson, H.W., Wawire, N.H.W., and Nafukho, F.M., 2010. Factors affecting the management of women groups' micro and small enterprises in Kakamega District, Kenya. *Journal of European industrial training*, 34 (2), 128–152.
- Nkonya, E., et al., 2008. *Linkages between land management, land degradation, and poverty in sub-Saharan Africa: the case of Uganda*. Washington, DC: International Food Policy Research Institute, Research Report 159.
- Odada, E., Olago, D., and Ochola, W., eds., 2006. *Environment for development: an ecosystems assessment of Lake Victoria basin environmental and socio-economic status, trends and human vulnerabilities*. Nairobi: UNEP/PASS.
- Ostrom, E., 1990. *Governing the commons: the evolution of institutions for collective action*. Cambridge: Cambridge University Press.
- Pandolfelli, L., Meinzen-Dick, R., and Dohon, S., 2008. Gender and collective action: motivation, effectiveness and impacts. *Journal of international development*, 20, 1–11.
- Pender, J., Place, F., and Ehui, S., eds., 2006. *Strategies for sustainable land management in the East African Highlands*. Washington, DC: International Food Policy Research Institute.
- Pretty, J. and Ward, H., 2001. Social capital and the environment. *World development*, 29 (2), 209–227.
- Pretty, J., Toulmin, C., and Williams, S., 2011. Sustainable intensification in African agriculture. *Journal of international agricultural sustainability*, 9 (1), 5–24.
- Putnam, R.D., 1993. The prosperous community: social capital and public life. *American prospect*, 13, 35–42.
- Quisumbing, A., et al., 2011. Gender and the global food-price crisis. *Development in practice*, 21, 488–492.
- Rarrieya, M. and Fortun, K., 2010. Food security and seasonal climate information: Kenyan challenges. *Sustainability science*, 5, 99–114.
- Sanchez, P., 2002. Soil fertility and hunger in Africa. *Science*, 295, 2019–2020.
- Scoones, I. and Thompson, J., eds., 2009. *Farmer first revisited: innovation for agricultural research and development*. Rugby: Practical Action Publishing.

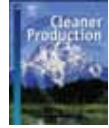
- Smit, B. and Wandel, J., 2006. Adaptive capacity, adaptation and vulnerability. *Global environmental change*, 16, 282–292.
- Smit, B., et al., 2000. An anatomy of adaptation to climate change and variability. *Climatic change*, 45, 223–251.
- Smithers, J. and Smit, B., 1997. Human adaptation to climatic variability and change. *Global environmental change*, 7, 129–146.
- The Standard, 2011a. Kilifi residents plead for food aid as crises unfolds. *The Standard*, 7 January, p. 12.
- The Standard, 2011b. High alerts as famine grips NEP. *The Standard*, 12 January, p. 7.
- Swidler, A., 1986. Culture in action: symbols and strategies. *American sociological review*, 51 (2), 273–286.
- Thomas, T.S.G. and Twyman, C., 2005. Equity and justice in climate change adaptation amongst natural-resource-dependent societies. *Global environmental change*, 15, 115–124.
- Thomas-Slayer, B. and Rocheleau, D., eds., 1995. *Gender, environment, and development in Kenya: a grassroots perspective*. Boulder: Lynne Rienne Publisher.
- Thompson, J. and Scoones, I., 2009. Addressing the dynamics of agri-food systems: an emerging agenda for social science research. *Environmental science & policy*, 12 (4), 387–397.
- Thornton, P.K., et al., 2010. Adapting to climate change: agricultural system and household impacts in East Africa. *Agricultural systems*, 103, 73–82.
- Toulmin, C., 2009. *Climate change in Africa*. London: Zed Books.
- Uganda Bureau of Statistics, 2002. *Uganda national household survey*. Entebbe: UBS.
- Vogel, C. and Smith, J., 2002. Politics of scarcity: conceptualizing current food security crisis southern Africa. *South African journal of science*, 98 (7/8), 315–317.
- Wenger, E., 1998. *Communities of practice: learning, meaning, and identity*. Cambridge: Cambridge University Press.
- Wenger, E., McDermott, R., and Snyder, W., 2002. *Cultivating communities of practice*. Cambridge: Harvard Business School Press.
- Woolcock, M., 2010. The rise and routinization of social capital, 1988–2008. *Annual review of political science*, 13, 469–487.
- Ziervogel, G., Bharwani, S., and Downing, T.E., 2006. Adapting to climate variability: pumpkins, people and policy. *Natural resources forum*, 30, 294–305.





Contents lists available at SciVerse ScienceDirect

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

Widows: agents of change in a climate of water uncertainty

Sara Gabriellsson*, Vasna Ramasar

Centre for Sustainability Studies, Lund University (LUCSUS), PO Box 170, 221 00 Lund, Sweden

ARTICLE INFO

Article history:
Received 4 April 2011
Received in revised form
5 December 2011
Accepted 26 January 2012
Available online xxx

Keywords:
Agency
Climate variability and change
Collective action
Water stress
Widows
Kenya

ABSTRACT

The African continent has been severely affected by the HIV and AIDS pandemic and as a consequence, development is being obstructed. Agriculture and food production systems are changing as a result of the burden of the pandemic. Many farming families are experiencing trauma from morbidity and mortality as well as facing labour losses and exhaustion. To further exacerbate the situation, climate variability and change reduce the available water supply for domestic and productive uses. This article describes how these multiple stressors play out in Nyanza province in Western Kenya and explores livelihood responses to water stress in Onjiko location, Nyanza. In this community, widows and divorced women affected by HIV and AIDS have become agents of positive change. Data from local surveys (2007), mapping of seasonal calendars (September 2009) and numerous focus group meetings and interviews with women in Onjiko (October 2008, January 2010, January 2011), reveal that despite a negative fall-back position, widows are improving their households' water and food security. This adaptation and even mitigation to some of the experienced climate impacts are emerging from their new activities in a setting of changing conditions. In the capacity of main livelihood providers, widows are gaining increased decision making and bargaining power. As such they can invest in sustainable innovations like rain water harvesting systems and agroforestry. Throughout, they work together in formalized groups of collective action that capitalize on the pooling of natural and human resources as well as planned financial management during hardship periods.

© 2012 Elsevier Ltd. All rights reserved.

1. Introduction

The HIV and AIDS pandemic is fundamentally changing food production systems across Sub-Saharan Africa. Many farming families are not only traumatized but also labour exhausted. Climate variability and change is adding to this burden by reducing the availability of water for domestic and productive uses, thereby altering longstanding customary farming cycles (Thornton et al., 2010). In the Nyanza province of Western Kenya the prevalence of HIV is estimated to be as high as 15 percent of the population and even higher among widowed and divorced women (Okuro, 2008). The challenges facing women engaged in farming in this region are daunting including a dependence on rain-fed agriculture, decreasing soil fertility, reduced availability of arable land and soil erosion (Ekbohm et al., 2001; Misselhorn, 2004; Odada et al., 2004).

Parallel to these changes in local environmental and social conditions are two significant socio-economic transitions currently underway across Sub-Saharan Africa. The first relates to the increased availability and access of affordable foreign goods and

services, primarily from China, such as bikes, cook ware, mobile phones into rural areas of Africa (Miles, 2007). The second is the change in the organization of labour where agricultural work in rural areas is increasingly replaced by non-agricultural work, unpaid work becomes paid and activities formerly performed by a household are now becoming more individualized (Francis, 2000; Ellis, 2000; Bryceson, 2002). These two socio-economic transitions have led to a more cash-based economy and this indicates a radical shift away from subsistence farming and an emergence of 'multiple livelihoods' whereby rural communities are compelled to diversify non-farming activities to generate cash to secure livelihoods and buy these foreign goods (Bryceson, 2002). However the lack of jobs, open markets and infrastructure in rural areas are leaving many rural Kenyans with few means of acquiring the cash to buy these products (Miles, 2007). Hence, this "quasi-development leaves many Africans having an increased need for cash but with limited means to generate it" (Miles, 2007: 2).

Such a radical shift towards more monetary reliant livelihoods, has significant implications for the individual farming household, and even more so when considering the convergence of these dynamic socio-economic factors and other multiple stressors affecting local livelihood security such as HIV and AIDS (Ramasar and Erskine, 2002).

* Corresponding author.

E-mail address: sara.gabriellsson@lucsus.lu.se (S. Gabriellsson).

For rural women in western Kenya this stage of development is uniquely challenging. Not only do women in rural Kenya lack the access and control over many of the necessary livelihood assets – land, money, credits, farming tools, education, household entitlements, food security – that they need to increase their adaptive capacity (Bryceson, 2002; Denton, 2002). The gender differentiated rights and responsibilities of women and men are also posing greater impediments to women's ability to cope with the impacts and adapt to the anticipated changes (Masika, 2002). The access to and availability of many of these livelihood assets are determined by locally specific gendered norms and institutions, such as marriage, polygyny, bridewealth and widow inheritance. These norms and institutions structure the way rural farming livelihoods are organized. For many women these gendered regimes are contributing to their disempowerment because they are being denied the ability to make the choices that delineates their lives and livelihoods (Kabeer, 1999). As sole heads of households, widows are particularly vulnerable because they have to carry the burden alone as well as facing marginalizing social and cultural norms. The added burden of possibly living with HIV themselves reduces their adaptive capacities even more and may even make them outcasts in their own community.

In this article we will not explore these perceived gender differentiated roots and impacts in great detail but instead focus on the way widows in Western Kenya respond to the livelihood changes in various domains and spatial scales. Using feminist political ecology as a theoretical framework we attempt to illustrate how widows, despite their 'weak fall-back position' (Agarwal, 1997) are responding to water scarcity and uncertainty through increased empowerment and collective action.

2. Research approach, methods and focus of activities

This article draws upon empirical data gathered by the lead author during five years in one farming community located near Lake Victoria in western Kenya (Fig. 1). Proceeding from a framework of climate vulnerability (O'Brien et al., 2007) this article focuses specifically on understanding how widows in Onjiko location have adopted innovative livelihood strategies to respond to climatic and water insecurity in restrictive political, ecological, cultural and economic circumstances.

The study is firmly rooted in an interpretative research epistemology (Mikkelsen, 1995). This implies that we take our departure

point in the knowledge and experience of local farmers (including widowed farmers who are head of their households) to induce and generate conceptual tools that are used to interpret and structure the empirical data in an iterative process (Bryman, 2008). As such, this research study is primarily, but not exclusively, based on a qualitative research methodology where one seeks to understand and explain the reasons for and the dynamics of a phenomenon rather than measuring or quantifying the existence of the phenomenon (Flick, 2006).

A combination of various methods (Table 1) including a baseline household survey, episodic interviews, seasonal calendars, multi-stakeholder workshop, periodic group interviews and focus groups, allowed for data triangulation (Bryman, 2008).

For this in-depth study, thematic analysis has been employed, whereby the empirical data is clustered around recurring themes in the various interview transcripts. Common themes that arose included farmers' experience of changes related to natural conditions, food and water security situation, collective action over time, cultural practices, barriers to social change and innovation in coping strategies.

3. Study setting

3.1. People and livelihoods in Onjiko

Onjiko location is situated 30 km east of the city of Kisumu, which is the capital of Nyanza province as well as the third largest urban settlement in Kenya. In Kenya, locations are administrative regions referring to the fourth level of subdivisions below provinces, districts and divisions. Onjiko is inhabited by the Luo, one of the largest ethnic groups in Kenya numbering over three million (Daily Nation, 2000). Luo culture is patrilineal and patrilocal and this has many repercussions for women and widows alike. Inheritance of property, i.e. land, follows the male lineage and customary laws prohibit Luo women to own land. The institution of marriage, the cultural practices of bridewealth and widow inheritance defines both gender-appropriate roles of manual labour as well as gendered rights and responsibilities within Luo society (Miles, 2007). Consequently, virtually all power and wealth in the community lie in the hands of elderly males.

HIV prevalence rates are higher in Nyanza than in other parts of Kenya with 15.1 percent at the provincial level in comparison to that of the national average of 6.7 percent (CBS, 2004, p. 17).



Fig. 1. Onjiko location in western Kenya, 00° 11'22" S 34° 54'53" E. Source: Google Maps.

Table 1
Fieldwork data collection strategy in Onjiko location, Kenya.

Type of method	Selection	Respondents in Onjiko	Focus of data collection
1. Baseline household survey (2007)	Households randomly selected in locations based on exposure to drought/floods	50 households	Demographics, livelihood activities and assets, agricultural practices, health issues, water use and availability, climate information, drought and flooding impacts, coping mechanisms, assistance
2. Episodic interviews (2008)	Farmers above 60 years of age, selected from among the respondents in HH survey	Three elderly farmers	Comparisons of changes over time including, climate, income sources, agricultural production and marketing, access to natural resources, livelihood diversification, labour responsibilities, coping strategies, food security
3. Periodic group interviews (2007, 2008, 2010)	One with women only and one with mixed men and women	Two farming groups ($n = 15$ and 24 members/group)	Perceptions on climate induced changes, perceived impacts on livelihoods and range of responses both short and long term
4. Seasonal calendars (2009)	Active formalized group with mixed gender membership	15 members	Mapping of climate, health, income, expenditure, food production and consumption during an average year.
5. A two-day multi-stakeholder workshop (2010)	One with local, national and regional stakeholders from both Kenya and Tanzania representing various sectors	65 people, incl. representation from one active Onjiko group	In split groups and plenary session identify impacts of climate variability and change on local communities, current coping and adaptation strategies, alternative future pathways, synergies and future needs for collaboration between existing actors.
6. Focus groups (2011)	Widows only	Two active groups ($n = 6$ widows/group)	Focused discussions on the additional challenges and opportunities of being a widow in a small holder farming context in Kenya

Moreover, studies have indicated that HIV prevalence rates vary significantly between various ethnic groups, with Luo's having the highest prevalence, with 17.5 percent of men infected and 25.8 percent of women living with HIV (ibid). The Luo cultural practice of polygyny, whereby men are allowed to have more than one wife, may have some influence on these statistics since men and women in polygynous unions are more likely to be HIV-infected (11.6 percent) in comparison to monogamous unions (6.9 percent) (ibid). Partly due to AIDS-related deaths, there are many widows living in Onjiko and our survey data and interviews also confirmed this fact. As many as 15 households out of 50 in the survey are headed by a widow. According to our interviews these numbers may be underestimated, widows themselves suggest that almost half the households in the community are headed by a widow.

The area is characterized by mixed farming livelihoods with agriculture and livestock farming. Farmers grow crops such as maize, sorghum, cow peas, and various vegetables and keep livestock including chickens, goats, cattle and some dairy cows. In addition to farming a majority also rely on off-farm incomes in order to survive. In 1999 the community had 8085 inhabitants. As many as 6288 individuals or 78 percent were estimated to live below the monetary poverty line, which then was calculated to be 1239 Ksh per person per month (CBS, 2003). Since 1999 the Nyando district population has grown from 299,000 to 395,000 people in 2010 (CBS, 2010). While government data on current poverty rates in Onjiko are missing our baseline household survey indicate a livelihood situation similar to the one in 2003, whereby a majority of households lack home-grown food throughout the year while animal proteins are consumed on an irregular basis. Buying food during long periods of the year is therefore necessary for many families. Off-farm incomes and remittances from relatives and children are important in order to sustain their livelihoods.

3.2. Land, climate and water

In Onjiko, land appears to be fertile and most of the land cover is crop land or savanna. However, scientific data show that both climatic and environmental changes are contributing to a decline in agricultural productivity, deterioration of water quality and quantity and loss of biodiversity (Hulme et al., 2000; Odada et al., 2009). These changes coupled with past and present unsustainable land-use practices in combination with steady population growth are

increasing the stress on the land as well as water resources available to farmers in the area (Odada et al., 2004). Since agricultural production in Onjiko is predominately rain-fed, changes in the total amount of rainfall, or more importantly, the spatial and temporal variability of rainfall, have palpable effects on agricultural performance (Slegers and Stroosnijder, 2008). The magnitude of these impacts is difficult to predict however. The climatic patterns of eastern Africa are associated with interlinked, complex, and not yet fully understood climate drivers, such as the movements of the Inter-tropical Convergence Zone, the large scale (African) monsoonal winds, the El-Nino Southern Oscillation phenomena (ENSO), the quasi-biennial oscillation, the meso-scale circulations and extra-tropical weather systems (Kizza et al., 2009). These complexities in combination with lack of sufficient local climate data, few sub-regional climate change scenarios using regional climate models or empirical downscaling, and the restricted computational facilities available in Nyanza as well as the lack of trained modellers make future climate change impacts for the region difficult to discern (Hudson and Jones, 2002; Swart et al., 2002; Jenkins et al., 2002).

Although significant uncertainties remain, a few local studies indicate an increase in precipitation with climate change and this will be accompanied by a spread of vector borne diseases like malaria and dengue fever (Thornton et al., 2010; Githeko, 2009). Variability of rainfall are also predicted to increase as well as instances of extreme weather events, such as prolonged drought and flooding (Conway et al., 2009). Not only will this affect agricultural production as discussed above but water availability and quality will most likely be affected (Eriksen et al., 2005). However, attributing these impacts solely to variations in climate is problematic since other factors such as over-fishing, industrial pollution and sedimentation are also degrading the tributary water sources around Lake Victoria (Odada et al., 2004).

4. Framing widowhood in Onjiko through feminist political ecology

4.1. Feminist political ecology

From a feminist political ecology perspective, environmental change and ecological conditions are products of political economic processes, albeit with an emphasis on gender as a critical variable to

be studied (Rocheleau et al., 1996). Three key fundamental assumptions guide all political ecology thought. First, that the costs and benefits of environmental change are for the most part distributed unequally among actors. Second, these unequal distributions of impacts inevitably reinforce or reduce other already existing social and economic inequalities. Third, these combined factors have political implications in terms of transformed power relations between the actors involved (Bryant and Bailey, 1997; Robbins, 2004). In a natural resource dependency setting such as the one in this study, these assumptions are useful to bear in mind when analyzing the current situation, especially in relation to gender.

In this study the theme of gendered environmental rights and responsibilities within feminist political ecology is used as an analytical framework since these rights and responsibilities predominately inform and delineate the choices small scale farmers (including widows) in Onjiko have to sustain their lives and livelihoods. Moreover we approach these gendered structural positions with the recognition that local experiences are manifestations of 'situated knowledge's' that are shaped by a multitude of dimensions of identity and differences, including gender, among others (Harding, 1986; Haraway, 1991; Mohanty, 1991).

A feminist political ecology framework links the challenges that widows face in sustaining livelihoods and quasi-development, rural labour transformations, HIV and AIDS, and water insecurity. These factors combine to exacerbate the inequalities faced by widows in sustaining their livelihoods and that of their children. In Onjiko, the specific political, ecological, cultural and economic setting means that women, and widows in particular, face multiple challenges as a result of gendered social norms and institutions.

4.2. Gendered norms and institutions in Onjiko

In Onjiko gendered responsibilities, or obligations rather, are reflected through the differentiated amount, types and spheres of labour that women and men engaged in. Women are predominately bound to reproductive and productive activities within the domestic sphere, while men are seen to be responsible for everything else. Gender differences are also seen in how men and women keep and use cash and their mobility and presence in public domains. Luo culture is also patrilineal, and subsequently not an egalitarian affair, since women upon marriage must relocate and live with the family of the husband. Polygyny is another aspect of the gendered norms delineating lives in Onjiko. Many men have more than one wife and that in turn limits wives' access to and availability of resources within the household, since household sizes are generally larger and the share of their husband's land, wealth and attention therefore lessened (Miles, 2007).

A demonstration of gendered rights within Luo society is the widespread practice of widow inheritance or *ter* in the Luo language, which refers to a culturally sanctioned 're-marriage' (Gunga, 2009). Through widow inheritance, a male relative of the deceased husband takes over the guardianship of the deceased's family, including the wife, so that the deceased's inherited property stays in the family (Miles, 2007). In Luo culture, the widow remains the wife of the deceased, although the guardian serves in the deceased husband's place, both physically and sexually. Hence, Luo widows are sometimes called 'widows of the grave' (Luke, 2002). In the past, the custom of widow inheritance was used as a social welfare mechanism to ensure that women and children were always taken care of, even upon death of the household head. Traditionally, the custom gave the woman the right to choose the male whose family she would be a part of and the right to continue to maintain a separate household (Potash, 1986). She had no domestic responsibilities toward the inheritor, but the inheritor

could help the widow with ploughing, school fees or building a house (ibid). In the past, as well as today, widows are expected and required to participate in a sexual cleansing ritual before being re-incorporated into society (Ambasa-Shisanya, 2007). Then and now the threat and punishment of incurring cultural impurities for themselves and their children acts as a motive for continuing to participate in the ritual, despite the potential risk of attracting HIV (Gunga, 2009).

Although the Kenyan constitution, under the Law of Succession Act, does assign widows limited rights to their matrimonial homes, the practice of widow inheritance is still widespread among Luo communities. Ironically, widowhood in recent years has become more challenging, resulting in higher health risks and heavier work and expenditure burdens (Luke, 2002; Gunga, 2009). Out of fear of getting infected with HIV many local men in Onjiko are refusing to inherit widows. This has given rise to a new profession in Luo society, namely the 'professional inheritor', often a young, single male from another locality who inherits numerous widows with the benefit of acquiring the wealth of the deceased husbands and enjoying numerous, legitimate sexual partners (Gunga, 2009). From the widows' perspective not only are they presently more at risk of attracting sexually transmitted diseases, including HIV, from unrelated outsiders but they are now also expected to support these professional inheritors with food, clothing and domestic upkeep (ibid). The welfare support system once established to assist widows and their children in times of dire needs has today been replaced by a system that leaves widows with heavy financial burdens and without any of the labour relief. Hence, inheritance is today a disadvantageous practice for widows. In response, some widows refuse to be inherited. Others, who lack an income, and therefore fear being without any entitlements to the estates of their deceased husbands, feel the pressure to go through ritual cleansing, which socially designates them as inherited. Some later leave their inheritor or "chase him away" (Luke, 2002). This has been the experience of many of the widows participating in this study, as seen below.

I did move for five years with another man after my husband died, to the in-laws not the brother, but he became a drunkard so I moved away because he was beating me and causing trouble - Dolphine, January 11th 2011

What these examples of the gendered norms and institutions shows us is how deeply rooted the gendered structural roles in Luo society really are and how these are continuously contributing to marginalizing women and widows in particular.

5. The challenges and opportunities of widowhood in Onjiko

The death of a husband in Onjiko, as elsewhere in Kenya, has tremendous impacts on the livelihoods of those left behind. Normally, a 'weak fall-back position' (Agarwal, 1997) as occurs in Luo culture would be a significant disadvantage for most women, but there are also examples of the opposite, where a precarious situation actually creates opportunities for women. The empirical findings of this study identified both opportunities and obstacles of this and these are illustrated and discussed next with direct quotes from interviews and survey results.

5.1. Managing on your own

The widows participating in this study in Onjiko confirm that they face a multitude of challenges including increased work loads, reduced incomes, rising incidence of diseases with ensuing healthcare expenditures and social exclusion (Table 2).

Table 2
Differences between female and male headed household livelihood conditions in Onjiko.

Livelihood characteristics and conditions in Onjiko Sample size: 50 Households	Female ^a headed HH 22		Male headed HH 28		
	a)	b)	a)	b)	
Median size of HH	4		6		
Food sufficiency (months/year)					
a) 10–12 months	b) 1–3 months	9	2	10	4
Animal protein consumed (days/week)					
a) 1–3 days	b) every day	14	0	21	2
Land size (acres/HH)					
a) <1 acre	b) 1–3 acres	12	8	8	17
Reliance on off-farm incomes					
a) very important	b) no importance	10	6	14	5
Reliance on remittance					
a) very important	b) no importance	11	8	3	18
Mobile phone ownership					
Main drinking water source					
a) bought piped water in dry season	b) uncovered rain water catchment in wet season	17	17	19	18
Time to fetch water					
a) dry season <10	b) wet season <10 min	9	20	7	20
Sanitary facilities					
a) improved pit latrine	b) bush only	3	9	6	5
HH afflicted by water related diseases in 06–07 year.					
Incidence of water related diseases					
a) malaria	b) typhoid	18	0	23	3

^a Out of the 22 female headed HH in the sample 15 are headed by widows.

When asking widows about their greatest livelihood challenges the majority responded that the increased work load is the most difficult factor to handle, since they are now alone with all the work duties and cannot split them with their husbands. Being the only breadwinner also puts a lot of pressure on them to provide for a great number of dependants (interviews indicated between three to 10 people per household).

Family members are generally aware of their mothers' struggles and those who can, chip in money through day-labour to pay for basic necessities such as food, healthcare, school fees and vended water during the dry season. Cash income opportunities are scarce, especially for children, but also for women while livelihood expenses are high. This makes reliance on home-grown food even more important for female headed households. But farming is a time consuming activity with no guarantees of success and the different tasks involved in the agricultural cycle, including clearing the land, plowing, planting, irrigating (if possible) weeding and harvesting entails weeks of strenuous full-time work. Widows must also tend to sick elders and children, feed animals, fetch water, collect fuel-wood, cook, clean and wash clothes. All of these tasks are done on foot and depend on reliable rainfall to secure availability of freshwater.

In the old days we would know when the rainy season started and ended. But now it is changing every year. Rose, Oct 23rd 2008

As indicated by Rose, widows in Onjiko are experiencing increased uncertainty in terms of onset of rain periods and unpredictable amounts of rain, affecting the outcomes of their food production negatively. Since many in Onjiko rely on uncovered rain water catchments, unprotected springs or rivers and streams flowing from Lake Victoria for their domestic and productive water needs, the majority of widows, and others in the community believe that ensuring a safe and healthy livelihood for their families is significantly harder today than 10–15 years ago, because of the water insecurity they are faced with.

Indeed, whether it is too little water or too much it has implications for all households, either for production or consumption or

because of expenses. Hence unless water availability, access and control is managed properly people will suffer. In Onjiko water shortage is a key limiting factor since many households get their productive water from a nearby river. At the same time it is also the flooding of these surface waters that causes problems during extreme rainfall periods.

Still water stress is more problematic, especially during the dry season, when supply is limited and competitive demand for water is high. In Onjiko this situation occurs every year, with varying severity, depending on how much the local river dries up. Agricultural production suffers during these periods as seedlings often get attacked by pests and planted crops dry out and wilt unless irrigated. Household sanitation standards and safe consumption are also inhibited thus contributing to a range of health problems including diarrhea, intestinal worms, trachoma, typhoid, malaria and dengue fever. Many of these diseases are linked to water, either through direct ingestion, transmission via vectors in surface waters or contamination from stored water during or after collection (WHO, 2010). Hence, not only is sufficient access to freshwater important but also the quality of that water is vital for health and well-being. For the widows in Onjiko, who are also living with HIV, it is indeed paramount to have access to clean water, as their immune systems are more vulnerable to infections (Aston and Ramasar, 2002). According to interviews and focus groups only a minority of households in Onjiko have access to freshwater from a secure, readily available and affordable water source, and many complain that the quality of their freshwater is increasingly becoming endangered. Many families are therefore forced to revert to unsustainable ways of accessing water, such as fetching water from more remote areas (1–2 h walks away), consuming dirty water from abandoned bore wells or buying vended or piped water from trucks or neighbours. These practices not only jeopardizes their health, but also diverts necessary labour and financial resources away from other areas where they are needed. Changes in climate and water security are thus environmental challenges that exacerbate the situation of widows in Onjiko striving to achieve sustainable livelihoods.

To make matters worse, widows are also socially excluded by virtue of being widows. The exclusion is made by both men and

women in the community. The informants give accounts of how men will ignore them in public places and how other women talk negatively about them behind their backs or leave when they come to local shops. Constance and Florence give their explanation for their social exclusion in the community:

We are seen as a threat to the community, especially to other women afraid of us taking their husband – Constance, January 11th 2011

They [other women] see us dress well, being full and stress-free, they are jealous because they have so much stress in their life because of the poverty in the household. And it is suppose to be up to the man to provide so that creates a lot of quarrels. For us that does not exist and that is great - Florence, January 15th 2011

The above testimonies show that part of the animosity towards widows is about fear, another about jealousy of a life perceived to be more stress-free than theirs. The situation is worse for those who are living with HIV, as evidenced by the quote below:

Only a few people know about my status, but I don't always like to close myself in a box, but there is so many things said about people with HIV, they connect it to bad work, prostitution, they connect it to so many dirty things. So you have to trust the person you tell otherwise they may stop talking to you, see you as a dog to stay away from – Nancy, January 22nd 2010

A feminist political ecology analysis of the situation would suggest that social exclusion of widows follows naturally in a patriarchal society where resources are delineated by gender lines and power relationships are challenged by independent widows. Thus, married women will rather attempt to disempower widowed women than lose the little power they have themselves as wives with access to male property and land. Similarly men's reluctance to give attention to widows in a productive resource setting is a way for them to discredit their rights to any other resources than those linked to reproduction. This removes any opportunities for challenging the authority of men, which is so intimately tied to claims over productive resources and the responsibilities attached to them (Francis, 2000). The evidence above shows some of the challenges of widowhood in Onjiko. Fig. 2 illustrates some of the ecological, cultural and economic stressors which intersect and interact on various scales.

As we will show in the following section these negative conditions have actually contributed to shaping the inspiring developments that are now unfolding in Onjiko, whereby widows are organizing themselves to respond to water and food insecurities and in the process gaining the means to initiate gender empowerment.

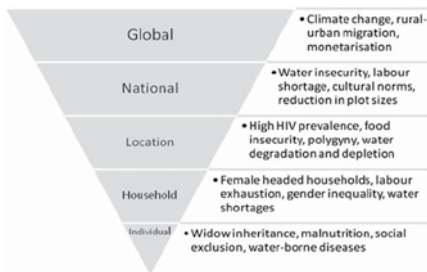


Fig. 2. . Examples of multiple stressors affecting widows in Onjiko at multiple scales.

5.2. The widow sisterhood

Widows in Onjiko stick together, not only because they are socially marginalized by other members in the community and society at large and thus contribute to similar livelihood struggles, but also because those shared experiences act as trust builders and subsequently a driving force for collaborative livelihood change. One example of how this collaborative action has been realized is through the formation of the Kobongo Farmer's Group. Through this group, the widows and others in the community have come together to improve their livelihoods.

There are strong ties between widows since they share the challenges with one another – Jane, January 15th 2011

Most of the people that we surround ourselves with are widows also - Ann, January 11th 2011

We do not listen to the voices of other people anymore, we choose our friends closely, only those that we can trust we have around us. In the group we know each other so well and there is nothing we cannot talk about with one another - Dolphine, January 11th 2011

Collective action is not new to this community, but in the past it was not formalized. Then these so called self-help groups would engage in labour pooling and financial support as an emergency response to individual households in need. But none of these activities were planned or came about as a result of an agreed upon collective vision. Today however the Kobongo Farmer's Group is registered nationally, which allows them to be eligible to apply for outside funding and participate in training workshops set up by government or non-governmental organizations. The group has a rigorous organizational structure where roles, duties and membership responsibilities are defined as well as set meeting procedures to be followed. A deliberative democracy approach is used in decision making and all the group members have a voice in the decisions and take responsibility for actions following the decision. This process gives the members power within the group and power over resources of the group. The collective decision making also gives the group power with those outside the group. As such the collective action performed by this group today is significantly different from the collective activities of the past.

We are the overall decision makers, whatever you will decide you will do it perfectly, without anyone else interfering, and whoever wants to interfere must be very ready to provide for you. And if you [men] are not ready to provide then don't interfere – Dolphine, January 11th 2011

You are your own self and you give your own questions and answers –Jane, January 15th 2011

Indeed, the widows interviewed for this study, were the first people in the community to form an organized collective group such as this. At the start in 2004, there were only seven members, today this has grown to 30, the majority of them being widows and including one man. Initially the group formation focused on the tasks of enabling collective labour on individual farm plots and engaging in petty businesses such as selling of dried fish. Today the group's activities have diversified extensively and now include both a village-saving and loan scheme; horticultural production and sales; farm irrigation through the building of water ponds; tree nursery; manure production; HIV support, outreach and advocacy; chair and table rentals for funerals and weddings as well as collective labour pooling on individual plots and a collective one.

The extra business that we are generating from our chair rentals and other small business we will invest in tents at the end of May and then we will attempt to start a catering business

because we are very good cooks and that will add to our income tremendously – Florence, January 15th 2011

The most tangible outcome of the group activities is probably related to the diversification of incomes. This has been possible in large part due to the regular weekly savings individual members have been making for the last couple of years. This has given the members a cash insurance pot to be used during periods of prolonged drought or extreme flooding events. It also acts as a planned security fund, from which they now retrieve money to make investment into livelihood arenas not accessible to them before, due to high initial capital costs. Consequently, the savings have facilitated investments into specialized farming such as horticulture and agroforestry. This brings them raised incomes from sales of vegetables and fruits and increases their nutritional intake from eating more vitamins and minerals. In addition, savings and raised incomes have allowed members to afford to buy larger and more valuable animals such as dairy cows and cattle. It allows for investments into various types of equipment and tools, such as sewing machines, fruit juice press, mobile phones, water tanks, solar stoves, smoke free stoves and renting of kick-start irrigation pumps. This has led to increased agricultural production and value adding activities while at the same time lowering the labour burdens of collecting fire wood and fetching water. Moreover, the diversification of incomes has secured funding to pay for school fees and unexpected illness in the family or to care for and prevent disease in animals.

The Kobongo Farming Group, through its collective action, long term planning, increased and diversified incomes has also adopted some improved water stewardship approaches. These include rain water harvesting from roofs, drip irrigation and water ponds to reduce water withdrawal. This has resulted in increased access and availability of water for households with subsequent improvement in family health and well-being. Agroforestry techniques implemented by the group also reinforce water and soil conservation by reducing soil erosion, which enhances rainfall infiltration and increases runoff, thereby controlling floods and sustaining water supply (Ekbon et al., 2001).

Some of us have a water tank, and even if it only rains a bit I at least get some [water]. We are getting tap water installed closer to the new house, so I can fill this tank up and then if the tap water is not coming for any reason I will have water, it gives me water, because it is so big, 1000 L. So this water can be a storage facility for my water and used for irrigation and for the animals – Nancy, January, 8th 2011

In sum, the introduction of new technologies through the strengthening of collaborative ties, founded on their shared gender experiences and their cultural, professional and ethnic belonging

has allowed the widows to seize opportunities and engage in prudent and protective use of water with positive outcomes for both food production and family well-being.

According to the group one reason for their continued progress in terms of activities and entrepreneurship is due to the common vision that they all share about the future. This vision is about securing a livelihood not only for themselves and their immediate family but also for the generation coming after them, hence their emphasis on using natural resources more consciously, and engaging in management practices that are more sustainable for their surrounding environment including water resources. Moreover, this progress is also founded on the persistence that each individual member and the collective as a whole show in their action strategies, which requires them to sometime wait to reap the benefits of their labour and investments instead of giving into temptations during hardship periods and harvest the more immediate and short term benefits of their activities. To that end they have managed to accrue long term benefits both for themselves and the environment around them that otherwise would not have materialized.

6. From victims to agents – exploring widows' empowerment in Onjiko

There is a growing body of evidence indicating that individuals and communities in the developing world can be highly resourceful in responding and adapting to external disturbances and change (see Andersson and Gabrielson, 2011; Olsson and Jerneck, 2010 for examples). This is especially true if there is 'head room' (Tompkins and Adger, 2004) for adaptation to occur at multiple temporal and spatial scales (Thomas and Twyman, 2005).

For the widows in Onjiko, the drivers of climate change and increased commodification of agricultural production in combination with HIV and AIDS has in a way created this 'head room'. Life as they used to know it does not exist anymore and that has required people to find new ways of making a living. From having seen widows as victims of a specific cultural and political context, we now see signs of widows as empowered agents attempting to transform their livelihood choices and conditions. Kabeer (1999: 437) defines empowerment as 'a process of change' rather than an end in itself, whereby people gain the ability to make choices they were previously denied. She conceptualizes the attainment of this ability as a three step progression entailing: *resources* (power to access), *agency* (power within and power to choose) and *achievements* (chosen outcomes).

The widows of Onjiko have become agents of change in their ability to access and control resources, previously inaccessible to them (Fig. 3). In the process, they have not only gained control over



Fig. 3. Three step progression of empowerment for widows in Onjiko, adapted from Kabeer (1999) and modified by the authors.

resources but also expanded their resource base which in turn, increases their empowerment.

Perhaps even more significant than the access to material resources, has been the increased agency that the widows have achieved. Groups provide widows "with an avenue to substantiate, negotiate and expand their autonomy" (Okuro, 2008: 134). Where previously widows had little power to make decisions over their own lives, their concerted action has allowed them to break the social norms and create new standards of behaviour and practice for widows and people living with HIV. The women are making choices for themselves about how they want to live and what they want to do with the resources they have. The women say they gain a sense of self worth and self esteem through the success and support of the group. There is increased networking, collaboration and mobility which shapes power within the group setting. In the process, the women's leadership has extended so that they are also contributing to the community more broadly and engage with local leaders and government officials in decision making processes. The women are participating in group settings not open to them before and act as role models in the community. This has the power to challenge and change gender relations in the community and reduce the power that others have over women.

Both the increased access and agency of the widows have led to many achievements including preventing crop failure, reduced work loads, increased nutritional intake, sustainable water management, diversified and increased income and planning for the future. The tangible outcomes of the group's success are already having benefits for individual households. Through the continued efforts of such innovative groups that have fought many obstacles to become agents of positive change, development gains are increasing. Some of the most significant gains have been for reducing poverty, improved child health and environmental sustainability, including better management of water resources.

7. Conclusions and recommendations

This article has highlighted the difficulties faced by people when dealing with multiple stressors in a restrictive political, ecological, economic and cultural context. Although climate variability and change with resulting water uncertainty will likely continue to exacerbate efforts to achieve sustainable livelihoods, especially in rural areas of East Africa, and particularly for vulnerable groups like widows, there are examples of situations when these circumstances may also lead to concerted and pragmatic action to improve livelihoods. The collective responses taken by the widows in this study illustrate how women, despite seemingly overwhelming obstacles, have managed to improve livelihoods and empower themselves by working together. The success of these collective efforts can be attributed to the social and political agency of the women involved and how that has transformed their abilities to make decisions for themselves regarding the future and sustainability of their livelihoods.

Today support for such local agency is largely missing in rural areas of East Africa, despite the fact that agency and collective action serves critical development and social support functions in local communities. Moreover, although future climate change is a global phenomenon, impacts and adaptation efforts will take place on the local level and that requires local agents to find their own appropriate strategies for adaptation (Demetriades and Esplen, 2009). Hence, national level 'one size fits all' policies are therefore likely to fail if the local cultural and gender context is not fully understood. For this reason, more attention needs to be paid to improving cultural and gender sensitivity and acceptance. Although the new law in Kenya are encouraging, at the household and community level, there is a need for campaigns to change

knowledge, attitudes and behaviour around HIV and AIDS and women's roles in society and ensure the implementation of legislation. Because it is important not just to recognize vulnerable groups but also give them voice in different forums to contribute to their own empowerment and that of others, as the widows of Onjiko have done.

Both policy changes and gender and cultural sensitivity must be focused on the local level. This goes hand-in-hand with improved knowledge of local environments, both natural and social. Building on existing local knowledge and institutions are key in our efforts towards viable climate adaptation in a specific area. External institutions should therefore seek ways to build upon the local institutions that are highly valued in an area or contribute most to peoples' livelihood goals, particularly those of women and poorer households (German et al., 2008).

During the course of this research, it became evident that there is a dire lack of available data and analysis on climate change and its impact on water availability at the local level, in Kenya and elsewhere in East Africa. Thus further research is needed that can generate local data for an integrated sustainability science, where both the natural and human aspects of change is taken into consideration. Only then will it be possible for us to fully understand the complexity of social change in the context of climate and water uncertainty in a specific setting.

Acknowledgements

The authors would like to extend their deepest gratitude to the ladies from Onjiko who participated in this study. Without their courage, honesty and engagement this article would never have been written.

We also want to thank Anne Jerneck at IUCSUS for much appreciated comments to earlier drafts of this article.

Funding for this research has been supported by the Swedish International Development and Cooperation Agency; the European Union through the 6th Framework Programme; The Craafood Foundation; The Gösta and Märta Moberg Research Fund and the Swedish Society for Anthropology and Geography.

References

- Agarwal, B., 1997. "Bargaining" and gender relations: within and beyond the household. *Feminist Economics* 3 (1), 1–51.
- Ambasa-Shisanya, C.R., 2007. Widowhood in the era of HIV/AIDS: a case study of Siaya District, Kenya. *Journal of Social Aspects of HIV/AIDS* 4 (2).
- Andersson, E. and S. Gabriëllson, 2011. "Because of poverty we had to come together" – collective action as a pathway to improved food security in rural Kenya and Uganda. *International Journal of Agricultural Sustainability*, Forthcoming.
- Aston, P., Ramasar, V., 2002. Water and HIV/AIDS: some strategic considerations. In: Turton, A., Henwood, R. (Eds.), *Hydropolitics in the Developing World: a South African Perspective*. African Water Issues Research Unit, Pretoria, pp. 217–235.
- Bryant, R.L., Bailey, S., 1997. *Third World Political Ecology*. Routledge, London.
- Bryceson, D., 2002. Multiplex livelihoods in rural Africa: recasting the terms and conditions of gainful employment. *The Journal of Modern African Studies* 40 (1), 1–28.
- Bryman, A., 2008. *Social Research Methods*. Oxford university press, Oxford.
- Central Bureau of Statistics (CBS) [Kenya], 2003. *Geographic Dimensions of Well Being in Kenya*. In: *Where Are the Poor: From Districts to Locations*, Nairobi, vol. 1. Central Bureau of Statistics (CBS) [Kenya], 2010. *National Census Report*. Nairobi.
- Central Bureau of Statistics CBS [Kenya], Ministry of Health (MOH) [Kenya] and ORC Macro, 2004. *Kenya Demographic and Health Survey 2003: Key Findings*. CBS, MOH and ORC Macro, Calverton, Maryland, USA.
- Conway, D., Persechini, A., Ardoin-Bardin, S., Hamandawana, H., Dieulin, C., Mahé, G., 2009. Rainfall and water resources variability in sub-Saharan Africa during the twentieth century. *Journal of Hydrometeorology* 10, 41–59.
- Daily Nation, February 17 2000. "We're 28 Million" in Daily Nation (Kenya).
- Demetriades, J., Esplen, E., 2009. The gender dimensions of poverty and climate change. In: *The Social Dimensions of Climate Change: Equity and Vulnerability in a Warming World*. New Frontiers of Social Policy, World Bank.
- Denton, F., 2002. Climate change vulnerability, impacts, and adaptation: why does gender matter? *Gender and Development* 10 (2).

- Ekbohm, A., Knutsson, P., Ovuka, M., 2001. Is sustainable development based on agriculture attainable in Kenya? A multidisciplinary case study of Murang'a district. *Land Degradation & Development* 12 (5), 435–447.
- Ellis, F., 2000. *Rural Livelihoods and Diversity in Developing Countries*. Oxford, UK.
- Eriksen, S., Brown, K., Kelly, P.M., 2005. The dynamics of vulnerability: locating coping strategies in Kenya and Tanzania. *The Geographical Journal* 171 (4).
- Flick, U., 2006. *An Introduction to Qualitative Research*. Sage Publications Ltd.
- Francis, E., 2000. *Making a Living, Changing Livelihoods in Rural Africa*. Routledge.
- German, L., Mazengia, W., Tirwomwe, W., Ayele, S., Tanui, J., Nyangas, S., Begashaw, L., Taye, H., Admassu, Z., M.TsegayeAlinyo, F., Mekonnen, A., Aberra, K., Chemangeni, A., Cheptegei, W., Tolera, T., Jotte, Z., Bedane, K., 2008. *Enabling Equitable Collective Action and Policy Change for Poverty Reduction and Improved Natural Resource Management in the Eastern African Highlands*. CAPRI (CGIAR). Systemwide Program on Collective Action and Property Rights. Working Paper No.86.
- Githeko, A.K., 2009. *Malaria and Climate Change*. Commonwealth Health Ministers' Update 2009.
- Gunga, S., 2009. The politics of widowhood and re-marriage among the Luo of Kenya. *Thought and Practice: A Journal of the Philosophical Association of Kenya* 1 (1), 161–174.
- Haraway, D., 1991. *Simians, Cyborgs and Women: The Reinvention of Nature*. Routledge, New York.
- Harding, S., 1986. *The Science Question in Feminism*. Cornell University Press, Cornell.
- Hudson, D.A., Jones, R.G., 2002. *Regional Climate Model Simulations of Present Day and Future Climates of Southern Africa*. Hadley Centre, Bracknell, 42 p. Technical Note 39.
- Hulme, M., Doherty, R., Ngara, T., New, M., Lister, David, 2000. *African climate change: 1900–2100 amprdqosemicolon*. Climate Research, April ed.
- Jenkins, G.S., Adamou, G., Fongang, S., 2002. The challenges of modelling climate variability and change in West Africa. *Climatic Change* 52, 263–286.
- Kabeer, N., 1999. Resources, agency, achievements: reflections on the measurement of women's empowerment. *Development and Change* 30 (3), 435–464.
- Kizza, M., Rodhe, A., Xu, C.-Y., Ntale, H.K., Hallidin, S., 2009. Temporal rainfall variability in the Lake Victoria basin in east Africa during the twentieth century. *Theoretical and Applied Climatology* 98 (1), 119–135.
- Luke, N., 2002. Widows and "Professional inheritors": understanding AIDS risk Perceptions in Kenya. Paper presented at the population Association of America Annual Meetings, May 8–11, Atlanta, GA.
- Masika, R. (Ed.), 2002. *Gender and Climate Change, Focus on Gender*. Oxfam, Oxford.
- Mikkelsen, B., 1995. *Methods for Development Work and Research: A Guide for Practitioners*. Sage Publications India Pvt Ltd.
- Miles, C., 2007. "Because Women Are Property": Issues of gender, food security, property Ownership, quasi-development and Religion in sub-Saharan Africa. UNU-WIDER Conference on Gender and Food Security, May 2007, Accra, Ghana.
- Misselhorn, A.A., 2004. What drives food insecurity in Southern Africa? A meta-analysis of household economy studies. *Global Environmental Change* 15, 33–43.
- Mohanty, C.T., 1991. Under western eyes: feminist scholarship and colonial discourses. In: Mohanty, C.T., Russo, A., Torres, L. (Eds.), *Third World Women and the Politics of Feminism*. Indiana University Press, Indianapolis.
- O'Brien, K., Eriksen, S., Nygaard, L.P., Schjolden, A., 2007. Why different interpretations of vulnerability matter in climate change discourses. *Climate Policy* 7 (1), 73–88.
- Odada, E.O., Olago, D.O., Kullindwa, K., Ntiba, M., Wandigga, Shem, Feb 2004. Mitigation of environmental problems in Lake Victoria, east Africa: causal chain and policy option analysis. *Ambio* 22 (1–2).
- Odada, E.O., Ochola, W.O., Olago, D., 2009. Drivers of ecosystem change and their impacts on human well-being in Lake Victoria basin. *African Journal of Ecology* 47, 46–54.
- Okuro, S.O., 2008. *Struggling with inlaws and corruption in Kombewa Division, Kenya*. In: Engler, B., Daley, B. (Eds.), *Women's Land Rights and Privatization in Eastern Africa*. James Currey, Fountain Publishers, EAEP, E&D Vision Publishing, UK.
- Olsson, L., Jerneck, A., 2010. Farmers fighting climate change – from victims to agents in subsistence livelihoods. *Wiley Interdisciplinary Review on Climate Change* 1, 363–373. May/June 2010.
- Potash, B. (Ed.), 1986. *Widows in African Societies*. Stanford University Press, Stanford.
- Ramasar, V., Erskine, S., 2002. HIV/AIDS: Africa's development crisis? In: Bajinath, H., Singh, Y. (Eds.), *Rebirth of Science in Africa: a Shared Visions for Life and Environmental Sciences*. Umadaus Press, Harfield, South Africa.
- Robbins, P., 2004. *Political Ecology: a Critical Introduction*. Blackwell, Oxford.
- Rocheleau, D., Thomas-Slayer, B., Wangari, Esther (Eds.), 1996. *Feminist Political Ecology*. Global Issues and Local Experiences. Routledge, London.
- Slegers, M.F.W., Stroosnijder, L., 2008. Beyond the desertification narrative: an agricultural drought framework for semi-arid East Africa. *Ambio* 37 (5).
- Swart, R., Mitchell, J., Morita, T., Raper, S., 2002. Stabilisation scenarios for climate impacts assessment. *Global Environmental Change* 12, 155–165.
- Thomas, T.S.G., Twyman, C., 2005. Equity and justice in climate change adaptation amongst natural-resource-dependent societies. *Global Environmental Change* 15, 115–124.
- Thornton, P.K., et al., 2010. Adapting to climate change: agricultural system and household impacts in East Africa. *Agricultural Systems* 103, 73–82.
- Tompkins, E.L., Adger, W.N., 2004. Does adaptive management of natural resources enhance resilience to climate change? *Ecology and Society* 9 (2).
- WHO, 2010. *Progress on Sanitation and Drinking-water*. 2010 Update. WHO/UNICEF, Geneva, Switzerland.

Appendix 1

CONFIDENTIAL

*Research on Adaptive Capacities to Climate Change Vulnerability in the Lake Victoria basin
Household Questionnaire- 2007
Sara Gabrielsson, PhD Candidate, Lund University Centre for Sustainability Studies, Sweden*

NAME OF INTERVIEWER	
DATE OF INTERVIEW	
INTERVIEW TIME	Start: _____ End: _____

A. LOCATION AND IDENTIFICATION DETAILS

A1. Form #:	A6. Name of Location Chief:							
A2. Country:	A7. Name of HH head:							
A3. Province:	A8. Marital Status of HH head:	1	2	3	4	5	6	7
A4. District:	A9. Sex of HH head?	1	2					
A5. Division:	Location:	A10. Name of respondent?						
A6. GPS Coordinates N/S:	A11. Relationship of respondent to HH head?	1	2	3	4	5	6	7

Please indicate responses answer by circling the options mentioned, or write the answer in full!

B. MAIN ACTIVITIES OF THE HOUSEHOLD

B1.	Type of agricultural household	1	2	3	4	5	
B1.1	What type of agricultural activities does this household engage in for the most part? (Circle all options mentioned)						Crop farming= 1 Horticulture= 2 Livestock= 3 Pastoralist= 4 Fishing = 5
B2.	Importance of livelihood activities						
B2.1	Rank the following livelihood activities/sources of income of the household in order of importance	Very Important= 1 Moderately important= 2 Small importance= 3 No importance= 4					
B2.1.1	<i>Annual crop farming</i>	Ex. Cassava, maize, rice, vegetables					
B2.1.2	<i>Perennial crop farming</i>	Ex. Sugarcane, Coffee, tea, banana, cotton					
B2.1.3	<i>Livestock keeping/herding/selling of prod.</i>						
B2.1.4	<i>Off-farm income</i>	Ex. Petty business, wage labour					
B2.1.5	<i>Remittances</i>	Ex. Money sent by relatives					
B2.1.6	<i>Fishing/hunting and gathering</i>						
B2.1.7	<i>Tree/forest resources/products</i>	Ex. Honey, firewood, timber, fruit					

C. HOUSEHOLD INFORMATION

C.1	Household statistics									
C.1.1	In your household how many are:									
a)	Males					Females				
	<6	7-18	19-35	36-55	>56	<6	7-18	19-35	36-55	>56
b)	Attending/finished school-					Never attended school-				
	Primary:		Secondary:		Tertiary:					
c)	involved in farming activities and to what extent?					Works on the farm-				
	Full-time			Part-time		Rarely			Never	

D. HOUSING FACILITIES & ASSETS

D1.	Housing Construction										
D1.1	For the main dwelling, what are the main building materials used in the construction of the house and rood?										
	1	2	3	4	5	6	Iron sheets= 1 Tiles= 2 Concrete= 3 Asbestos= 4 Grass/leaves= 5 Grass & mud= 6 Other = 7				
D1.2	(Circle all options mentioned)										
	How many rooms does the house have?							1	2	3	4

D2. Household Assets													
D2.1	What household assets does this household own? (Circle all options mentioned)	1	2	3	4	5	6	7	8	9	10	11	Cassette/ Music System= 2 Mobile Phone= 3 Iron= 4 Wheelbarrow= 5 Bicycle= 6 Vehicle= 7 Television= 8 Electric/gas cooker= 9 Mosquito nets= 10 Sewing machine= 11 Other, specify= 12
		12											
D3. Energy use by household													
D3.1	What is the main source of energy for lighting in the household? (Circle all options mentioned)	1	2	3	4	5	6	7	8				Mains electricity= 1 Solar= 2 Gas (biogas)= 3 Hurricane lamp= 4 Pressure lamp= 5 Wick lamp= 6 Candles= 7 Firewood= 8 Other, specify= 9
		9											
D3.2	What is the main source of energy for cooking in the household? (Circle all options mentioned)	1	2	3	4	5	6	7	8	9			Mains electricity= 1 Solar= 2 Gas (biogas)= 3 Bottled gas= 4 Paraffin/Keroene= 5 Charcoal= 6 Firewood= 7 Crop residues= 8 Livestock dung= 9 Other, specify= 10
		10											

D4.	Access to drinking water													Piped water= 1 Protected well= 2 Protected/covered spring= 3 Unprotected well= 4 Unprotected spring= 5 Surface water (lake/dam/river)= 6 Covered rainwater catchment= 8 Uncovered rainwater catchment= 9 Water vendor= 10 Tanker truck= 11 Bottled water= 12 Other, specify= 13												
D4.1	Where does the main source of drinking water for the household come from:																									
	a) In the wet season? (Circle all options mentioned)																									
	b) In the dry season? (Circle all options mentioned)																									
D4.2	What is the time spent to and from the main water source: a) in the wet season? b) in the dry season?													Write answer in hours and minutes.												
D5.	Access to toilet facilities																									
D5.1	What type of toilet does your household use?													No toilet/bush= 1 Flush toilet= 2 Traditional pit latrine= 3 Improved pit latrine- HH owned= 4 Other, specify= 5												
D6.	Food consumption patterns																									
D6.1	How many meals does the household normally eat per day?													1 meal/day= 1 2 meals/day= 2 3 meals/day= 3 More than 3= 4												

D6.2	How many days last week did the household consume animal protein?	1	2	3	4	None=1 1-3 days=2 4-6=3 Every day=4
D6.3	How many months was the household sufficient in food last year?	1	2	3	4	1-3 months=1 4-6 months=2 7-9 months=3 10-12 months=4

E. HOUSEHOLD HEALTH AND ACCESS TO SERVICES

E1.	Household health								
E1.1	In the last 2 years, which diseases have afflicted any of the members of the household? (Circle all options mentioned)	1	2	3	4	5	6	7	Malaria= 1 Pneumonia= 2 Opportunistic infections= 3 Tuberculosis= 4 Dengue fever= 5 HIV/Aids= 6 None= 7 Others, specify= 8
E1.2	Where do household members normally go for treatment when they become sick? (Circle all options mentioned)	1	2	3	4	5	6	Public health facilities= 1 Private health facilities= 2 Hospital= 3 Traditional healers= 3 Never go= 5 Other, specify= 6	
E2.	Access to health services								
E2.1	What is the distance to the nearest health care facility from your house?	Write in km							
E2.2	How much, on average, does the household spend on health care/month?	Write in KSh							

F. AGRICULTURAL ISSUES AND ACTIVITIES

F1.	L and size and type of crops											
F1.1	What is the size of the land used for agricultural activities by the household?											
F1.4	What type of crops are cultivated on this land? (Circle all options mentioned)											
	1	2	3	4	5	6	7	8	9	10	11	4
	Under 1 acre= 1 Between 1-3 acres= 2 Between 4-6 acres= 3 Above 6 acres= 4 Maize= 1 Paddy/rice= 2 Sorghum= 3 Millet= 4 Cassava= 5 Sugarcane= 6 Sunflower= 7 Various vegetables= 8 Cotton= 9 Various beans= 10 Various trees= 11 Other, specify= 12											
F2.	Farm inputs, investments and storage											
F2.1	What type of farm inputs, if any, have been applied on the land this year? (Circle all options mentioned)											
F2.2	What are some of the reasons for not using farming inputs? (Circle all options mentioned)											
	1	2	3	4	5	6	7	8	9	10	11	12
	Chemical fertilizer= 1 Farm yard manure/compost= 2 Pesticide/fungicide= 3 Herbicide= 4 Improved seeds= 5 No inputs= 6 Not available= 1 Price is too high= 2 Too much labour required= 3 Do not know how to use it= 4 Inputs is of no use= 5 Produces them locally anyway= 6 Not applicable= 7											

F2.3	Has the household stored any crops during the 2006/2007 agricultural year? IF 2→F3	1			2			Yes=1 No=2		
F2.5	What was the main method of storage?	1	2	3	4	5	6	In locally made traditional structure=1 In improved locally made structure=2 In modern store=3 In sacks/open drum=4 In airtight drum=5 Unprotected pile=6 Other storage type=7		
F2.6	What was the prime purpose for storage?	1	2		3			Food for the household=1 To sell for higher price=2 Seed for planting=3 Other purpose, specify=4		
F3. Agroforestry										
F3.1	How many planted trees does the household have on its land?	Write the number of trees. No trees=0								
F3.2	What agroforestry techniques are used on the cultivated land?	1	2	3	4	5	Alley cropping=1 Multipurpose tree species=2 Conservation agriculture=3 Improved fallow=4 Home garden=5 No agroforestry=6 Planks/timber=1 Poles=2 Charcoal=3 Fuel wood=4 Shade=5 Medicinal=6 Fruit for consumption=7 Fruit for sale=8 Not applicable=9			
F3.3	What is the main utility of the trees planted on the land?	1	2	3	4	5	6	7	8	9

F4. Agricultural productivity and earnings						
F4.1	Compared to 10 years ago, what is the agricultural productivity of the land today?	1	2	3	4	Better productivity= 1 Worse productivity= 2 The same productivity= 3 Not applicable= 4 Other, specify= 5 in Ksh
F4.2	Approximately how much cash income did the household earn from selling crops (food and cash) last year ?	5				
F4.3	Approximately how much cash income did the household earn by selling crops (food and cash) this year ?					in Ksh

G. CLIMATE ISSUES AND COPING STRATEGIES

G1. Weather patterns									
G1.1	How does the household get information about the weather? (Circle all the mentioned options)	1	2	3	4	5	6	7	Radio= 1 Neighbours= 2 Extension Services= 3 Television= 4 By word of mouth= 5 Mobile phone/phone= 6 From observing the landscape= 7
G1.2	Have you experienced changes in the weather in the past few years? IF 2→ G1.6	1			2		Yes= 1 No= 2		

G1.3	<p>How would you describe these changes in weather? (Circle all the mentioned options)</p>	1	2	3	4	5	6	7	<p>Decrease in rainfall amount= 1 Increase in rainfall amount= 2 Decrease in length of the rainy season/s= 4 Increase in the length of the rainy season/s= 5 Inadequate rainfall= 6 Increased incidence of extreme events (droughts/floods)= 7 Others, specify= 8</p>	
G1.4	<p>What, if any, impacts has these weather changes had on the livelihood activities of this household? (Circle all the mentioned options)</p>	1	2	3	4	5	6	7	8	<p>Decreased crop productivity= 1 Increased crop productivity= 2 Loss of cash income= 3 Increased cash income= 4 Decreased livestock= 5 Increased livestock= 6 Decreased fishing opportunities= 7 Increased fishing opportunities= 8 More ill health= 9 Less ill health= 10 Loss of employment= 11 Increased employment opportunities= 12 Loss of housing= 13 Drop out from school= 14 Other, specify= 15</p>
G1.5	<p>Has this year been a good or a bad rainfall year?</p>	1					2		<p>Good= 1 Bad= 2</p>	
G2.	Drought									
G2.1	<p>When was the last time you had a drought in this area?</p>									Write year

G2.2	What did the household encounter as the biggest problems during the drought? (Circle all the mentioned options)	1	2	3	4	5	Food shortages= 1 Water shortages= 2 Transport problems= 3 Diseases= 4 Unemployment= 5 Other, specify= 6			
G2.3	Did the household get any outside assistance (\$ or other) during the drought? IF 2→ G2.7	1	2					Yes= 1 No= 2		
G2.4	If yes, who gave you outside assistance during and after the drought?	1	2	3	4	5	6	Relatives= 1 Neighbours= 2 Local administration= 3 Government = 4 CBO/Foreign NGO= 5		
G2.5	What kind of outside assistance was given to enable the household to cope with the drought conditions? (Circle all the mentioned options)	1	2	3	4	5	6	7	8	Food support= 1 Water support= 2 Pest/crop management= 3 A loan= 4 Financial assis= 5 Health care= 6 Seeds= 7 Livestock= 8 Other, specify= 9
G2.6	What type of measures did the household employ to cope with the drought themselves? (Circle all the mentioned options)	1	2	3	4	5	6	Reduced food consumption= 1 Cutback of HH expenditures= 2 Took children out of school= 3 Sold household assets= 4 Diversified off-farm incomes= 5 Not applicable= 6 Other, specify= 7		
G2.7	Where did the households get seeds for planting after the drought had elapsed? (Circle all the mentioned options)	1	2	3	4	5	6	Relatives= 1 Neighbour= 2 Village shop= 3 Extension services= 4 CBO= 5 Government= 6		

G3. Floods												Yes=1 No=2 If yes, write year	
G3.1 Has this area had any flooding, if yes what year? IF 2→SURVEY FINISHED												Yes=1 No=2 If yes, write year	
G3.2 Did the household get any outside assistance (\$ or other) during or after the flood? IF 2→G3.5	1		2		3		4		5		6		Yes=1 No=2
G3.3 If yes, who gave the household the assistance you needed during and after the flood? (Circle all the mentioned options)	1	2	3	4	5	6	Relatives=1 Neighbours=2 Local administration=3 Extension Services=4 CBO/Foreign NGO=5 Government=6						
G3.4 What kind of outside assistance was given to enable the household to cope with the flood conditions? (Circle all the mentioned options)	1	2	3	4	5	6	7	8	9	10	Shelter=1 Transportation=2 Food support=3 Financial assistant=4 Health care=5 A Loan=6 Water management=7 Building material=8 Seeds=9 Livestock=10 Other, specify=11		
G3.5 What type of measures did the household employ to cope with the flooding themselves? (Circle all the mentioned options)	11											Reduced food consumption=1 Cutback of HH expenditures=2 Took children out of school=3 Sold household assets=4 Diversified off-farm incomes=5 Moved in with relatives=6 Moved away to another village=7 Not applicable=8 Other, specify=9	
	1	2	3	4	5	6	7	8					
	9												

THANK YOU SO MUCH FOR TAKING THE TIME TO PARTICIPATE IN THIS SURVEY, IT IS MUCH APPRECIATED BY SARA AND HER TEAM.

EVALUATION OF THE INTERVIEW
(TO BE COMPLETED BY THE ENUMERATOR)

DURING THE INTERVIEWS WAS THE RESPONDENT AT EASE? (1= YES 2= NO)	1	2
DO YOU THINK THAT THE RESPONDENT MADE HIS/HER BEST TO TELL THE TRUTH? (1= YES 2=NO)	1	2
HOW DO YOU VALUE THE USEFULNESS OF THIS INTERVIEW? (1= GOOD 2= SATISFACTORY 3= UNSATISFACTORY)	1	2 3
OTHER COMMENTS ABOUT THE RESPONSES FROM THE INTERVIEW THAT YOU THINK ARE IMPORTANT FOR THIS STUDY		
-		
-		
-		
-		
-		
-		
-		
-		

Appendix 2



Invites you to a workshop on:

Livelihoods and Climate Vulnerability in the Lake Victoria Basin

27-28 JANUARY 2010 IN KISUMU, KENYA

Venue:

Jumia Guest House, Kisumu.

Target groups:

Policy makers at regional level, intergovernmental organisations, NGOs and scientists interested in the theme: 'Adaptation to climate vulnerability and resource dependent communities.'

For questions please contact:

pamela.abila@viafp.org (Workshop practicalities, travels and housing)

sara.gabrielsson@lucsus.lu.se (Workshop contents)

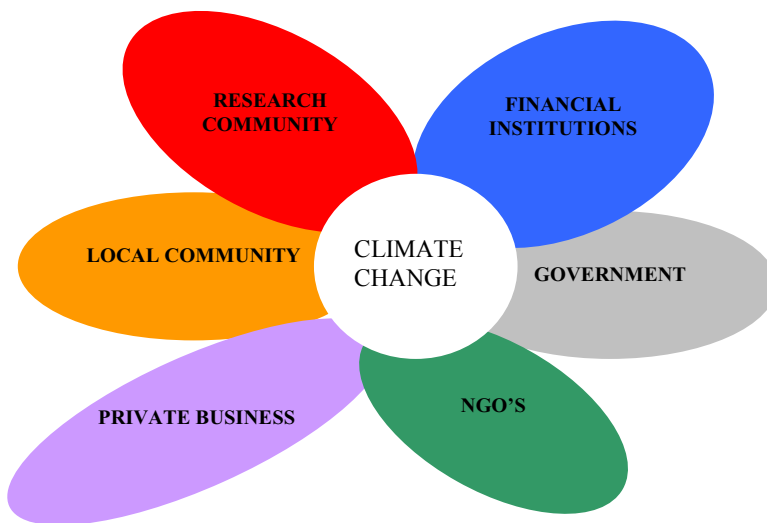
The Workshop Topic

The human-nature conditions of resource dependent communities in the face of a changing climate

Since time immemorial farmers in East Africa have planted and harvested their food crops and tended their livestock according to the seasons but now climate change is changing all of that. We see that many serious questions flow from these changes:

- What will happen to people's lives and livelihoods?
- How are farmers in the Lake Victoria basin affected by these changes today and how will they be able to survive and thrive in the future?
- What is being done on the ground right now to reduce these impacts?
- What can stakeholders do to make natural resource dependent communities adapt to these changes now and in the long term future?

These and many other closely connected issues will be examined and discussed during this two-day workshop.



Workshop contents

The workshop is designed to cover many different aspects of climate vulnerability by focusing both on links and variations between sectors, place, time and actors in the basin. And the methods to be used to capture this complexity are through presentations, group work sessions, round table discussions and plenary reflection.

In particular, we find it important to:

- Identify key problems areas and linkages to climate in various sectors
- Compare and contrast present place based conditions and variations in Nyando and Mara
- Explore plausible future scenarios in these same areas
- Discuss what stakeholders are currently doing in relation to climate and where and by whom collaborations can improve among and between stakeholders from local-global to enhance future local adaptation potential.

Workshop presentation topic issues

A. Sectors in society

What are the issues and linkages to climate in various sectors?

- Agriculture and livestock
- Water resources
- Health
- Forestry – Energy
- Entrepreneurship/Business development

B. National and global climate policy

What does it mean for East Africa and communities in the LVB?

C. Regional climate predictions and local adaptation capacity

What changes should local communities prepare for?

Do people have the capacity to adapt to those changes?

Confirmed participants include, among others, representatives from:

- **Red Cross**
- **Kenya Agricultural Research Institute**
- **Lake Victoria Environmental Management Project**
- **Makerere University**
- **Kenya Forestry Research Institute**
- **Lake Victoria Basin Commission**
- **Kenya Seeds Co. Ltd**
- **Equity Bank**
- **Swedish International Development and Cooperation Agency**
- **Kenya Medical Research Institute**
- **World Agroforestry Centre**
- **International Livestock Research Institute**
- **Kenya Marine Fisheries Research Institute**
- **UN Food and Agricultural Organization**
- **Maseno University**
- **Vi-Agroforestry Project East Africa**

Workshop Agenda

Day 1

Wednesday 27 January, 2010

- 8.00 - 8.30 Registration
- 8.30- 8.45 Welcome, Wangu Mutua, Programme Director VI –Kisumu, Lennart Olsson, Lund University Centre for Sustainability Studies
- 8.45 – 9.00 **Adaptation and mitigation potential of trees and soils, the VI experience**
Amos Wekesa, Climate Change Unit, Vi Agroforestry Kisumu
- 9.00 – 9.30 **Key Note Address - Climate change and the future of the LVB**
Dr. Washington Ochola, Programme Manager, Regional Universities Forum for Capacity Building in Agriculture, Uganda
- 9.30 – 10.30 Presentations (15 minutes each + questions):
- **Health and climate change in the LVB**
Dr. Githenko, Kenya Medical Research Institute
 - **Water resources and climate change, impacts and responses**
Mr. John Okungu, Water Quality Expert, Lake Victoria Environmental Management Project
 - **Climate change, opportunity or barrier for farm business?**
Alfred Busolo Tabu, Deputy Managing Director in Kitale, Kenya Seeds Ltd.
- 10.30 -10.45 Introduction to group session methods
Sara Brogaard, PhD. Centre for Sustainability Studies, LU
- 10.45 – 11.00** *Coffee and tea break*
- 11.00 - 12.30 **Group Session 1 - Communities**
Impacts of climate variability and change on livelihoods in LVB
- 12.30 - 13.30** *Lunch*
- 13.30 – 14.00 Plenary session - Reporting back from group session 1
- 14.00 – 15.00 Presentations (15 minutes each + questions):
- **Policy developments for climate adaptation and mitigation**
Patrick Chabeda, Asst. Co-Ord., Kenya Climate Change Coordination Unit, Office of the Prime Minister
 - **Funding local climate adaptation? Commercial community loans and the impact on resource dependent communities?**
Tom Kuyoh, Bank Manager, Equity Bank
 - **The Lake Victoria basin, A case study of climate vulnerability**
Sara Gabriellsson, PhD Candidate from Lund University Centre for Sustainability Studies

15.00 – 15.30	<i>Coffee and tea break</i>
15.30 – 17.00	Group Session 2 – Scenarios Alternative climate impacts and future pathways for adaptation
18.30 - 19.00	Film showings – Plenary Hall VI Agroforestry Project and LUCSUS Smokeless Stoves Project
19.00 – Late	Dinner at Jumia Guest House

Day 2

Thursday 28 January, 2010

8.30 - 9.00	Group Session 2 – Scenario wrap-up
9.00 - 10.00	Round table discussions - scenarios
10.00 – 10.30	<i>Coffee break</i>
10.30 – 11.15	Presentations (15 min each + questions) <ul style="list-style-type: none"> • COP 15 - what it means for East Africa? Dr. Henry Neufeldt, Chief Climate Scientist, ICRAF • Pooling of resources and increasing local food security Mrs. Dolphine Ogada, Onjiko microcredit group
11.15 - 12.30	Group Session 3 – Actors and Actions What can stakeholders do separately and together?
12.30 - 13.30	<i>Lunch - Continued group work</i>
13.30 - 14.00	Group Session 3 – Actors and Actions wrap-up
14.00 – 15.00	Plenary session – Report and Synthesize from Session 3
15.00 – 15.20	<i>Coffee break</i>
15.20 – 16.00	Moderator Reflection What have we learned and where do we go from here? Professor Lennart Olsson, Lund University Centre for Sustainability Studies

Workshop sponsor:



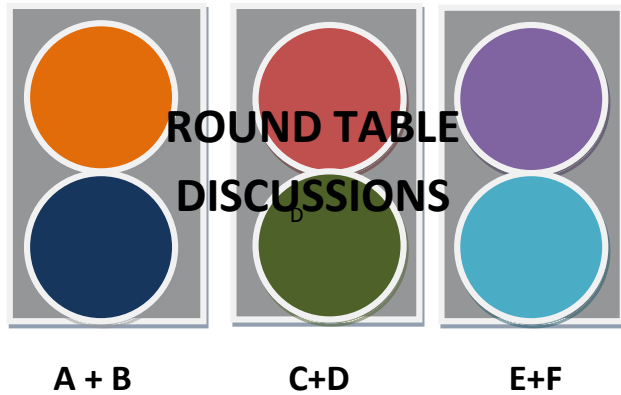
Appendix 3

PROGRAMME - THURSDAY 28TH

30 Min ↓



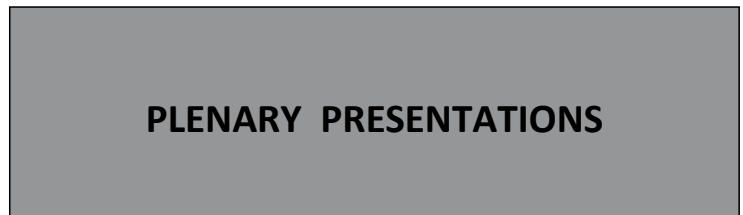
60 Min ↓



30 Min

COFFEE AND TEA BREAK

45 Min ↓



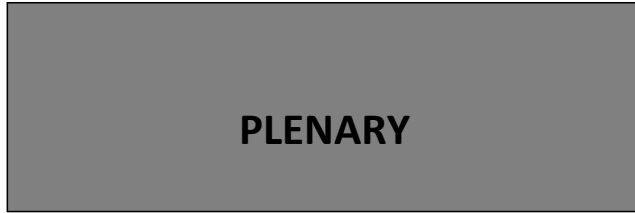
165 Min ↓



INCLUDING GROUP LUNCH

THURSDAY 28TH CONTINUED

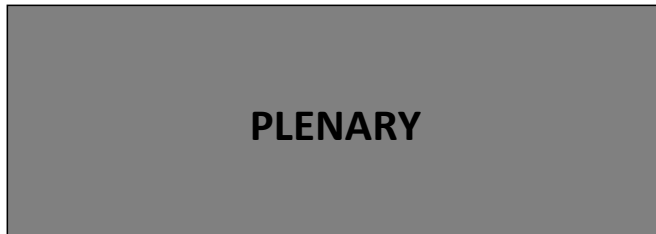
60 Min



20 Min

COFFEE AND TEA BREAK

40 Min



PARTICIPANT GROUPS

GROUP A



Joseph Matere	Lennart Olsson
Joshua Oduyo Opere	John Owour
Jennifer Ngaira	Elly Akoko
James Walusimbi	Willis Atie
John Okungu	Pamela Abila

GROUP B



Wangu Mutua	Benson Gudu
Faustin Rwamuhizi	Patrick Chabeda
Kenneddy Kitori	Gabriel Songa
George Ayaga	Connie Nekessa-Ouma

GROUP C



Joseph Maitima	Wycliffe Adongo
Nicholas Abuya	Björn Horváth
Wilson Odongo	John Ochieng Mumbo
Veronika Bisansaba	Marco Olum

GROUP D



Richard Abila	Henry Neufeldt
Abubakari Munga	Amos Wekesa
Wilfrieda Owade	Joseph Oginga Omulo
Godfrey M Mwangi	Elijah Muli
Dr. Katengesya	

GROUP E



Obiero Ong'ong'	Paskazia Mwesiga
Tom Kuyoh	Ali Said Matano
Sara Gabrielsson	Washington Ochola
Dolphine Ogada	Marwa Kitende

GROUP F



Michael Wamalwa	Andrew Githeko
Sara Brogaard	Peter Kabok
Enock Mati	Alfred Busolo Tabu
Amulike Nwaka	Juliana Shayo
Joseph Jagi	Martina Caretta

Lund Dissertations in Sustainability Science

1. *Barry Ness*: Sustainability of the Swedish sugar sector: assessment tool development and case study appraisal (2008)
2. *Karin Steen*: Time to farm: A qualitative inquiry into the dynamics of the gender regime of land and labour rights in subsistence farming: an example from the Chiweshe communal area, Zimbabwe (2011)
3. *Sara Gabrielsson*: Uncertain futures: Adaptive capacities to climate variability and change in the Lake Victoria Basin (2012)



LUCID

Lund University Centre of Excellence for Integration of
Social and Natural Dimensions of Sustainability

ISBN 978-91-7473-310-5