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Declaration

I, Marianne Mosberg, declare that this thesis is a result of my own research investigations and findings. Sources of information other than my own have been acknowledged and a reference list has been appended. This work has not been previously submitted to any other university for award of any type of academic degree.

Signature

Date.....

Abstract

This thesis investigates if local supply of solar energy can contribute to sustainable adaptation to climate variability and change, by examining the case of a decentralized solar energy centre in the remote, rural village of Ikisaya in Kenya. Sustainable adaptation is here understood as a process which involves leading a society on a development pathway that is socially and environmentally sustainable. Reducing vulnerability, caused by contextual conditions and multiple stressors, is an essential element of sustainable adaptation. This thesis therefore first examines how climatic and societal factors, and people's responses to these, shape the vulnerability context in Ikisaya. Findings from this research demonstrate that high inter-annual rainfall variability, erratic precipitation, frequent droughts and occasional floods, are the main climatic drivers of vulnerability in the area. Economic, political and socio-cultural factors, as well as conflicts and insecurity, are identified as the main societal factors that contribute to vulnerability. These climatic and societal factors are interlinked in a variety of ways. Furthermore, this thesis demonstrates that responses to contextual conditions and multiple stressors form an integral part of the vulnerability context. A variety of coping strategies and adaptive measures employed by people in Ikisaya are identified in this thesis. The coping strategies primarily focus on acquiring food or income through livelihood diversification, drawing on social networks, engaging in group activities, performing illegal activities or receiving emergency food aid from the government or church. These strategies generally provide marginal income, are instable, risky, and some are socially or environmentally unsustainable. Adaptive measures aim at enhancing agricultural productivity or securing access to water, but these are not available to most people due to high investment costs or manual labor demand. The thesis then investigates how Ikisaya Solar Energy Centre influences the vulnerability context in Ikisaya, and how climatic and societal factors in turn affect the viability of the Centre. Findings from this research show that the Energy Centre has a number of direct and indirect positive implications for livelihoods, education, and health. Yet, not everyone in the community is able to access the services at the centre. Climatic and societal factors are also found to influence the financial viability of the centre through fluctuating demand for the services.

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Nemovea Muno!

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Acronyms

AIC	African Inland Church
CBO	Community Based Organization
CDF	Constituency Development Funds
CPA	Charcoal Producer Association
D.C.	District Commissioner
DRE	Decentralized Renewable Energy
ENSO	El Niño Southern Oscillation
GHG	Greenhouse Gas
ICT	Information and Communications Technology
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
ITCZ	Intertropical Convergence Zone
KFS	Kenyan Forest Service
KSh	Kenyan Shillings (<i>Currency</i>), 1 KSH = 0,0151 USD (per 15.05.13).
KWFT	Kenya Women Financial Trust
KWS	Kenya Wildlife Service
LCA	Life-cycle analysis
MASL	Meters Above Sea Level
NFD	Northern Frontier District
NGO	Non-Governmental Organization

NSD	Norsk Samfunnsvitenskapelig Datatjeneste (Norwegian Social Science Data Services)
ODA	Official Development Assistance
OECD/DAC	The Organization for Economic Cooperation and Development/ Development Assistance Committee
PV	Photovoltaics
SHS	Solar Home System
UNFCCC	United Nations Framework Convention for Climate Change
USD	US Dollar (<i>Currency</i>)

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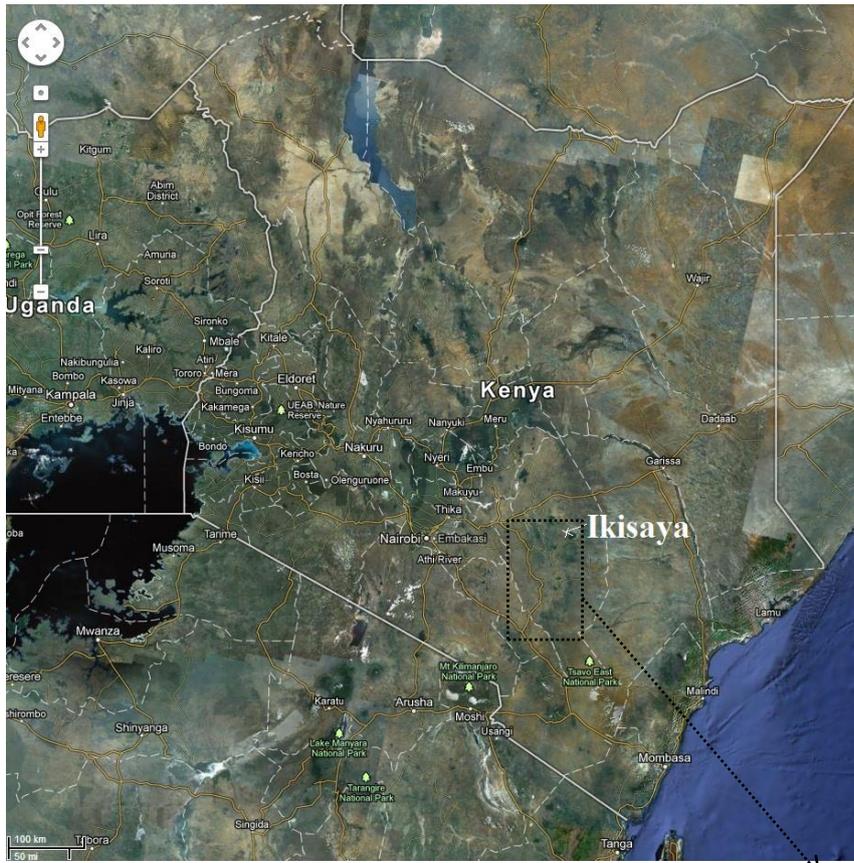
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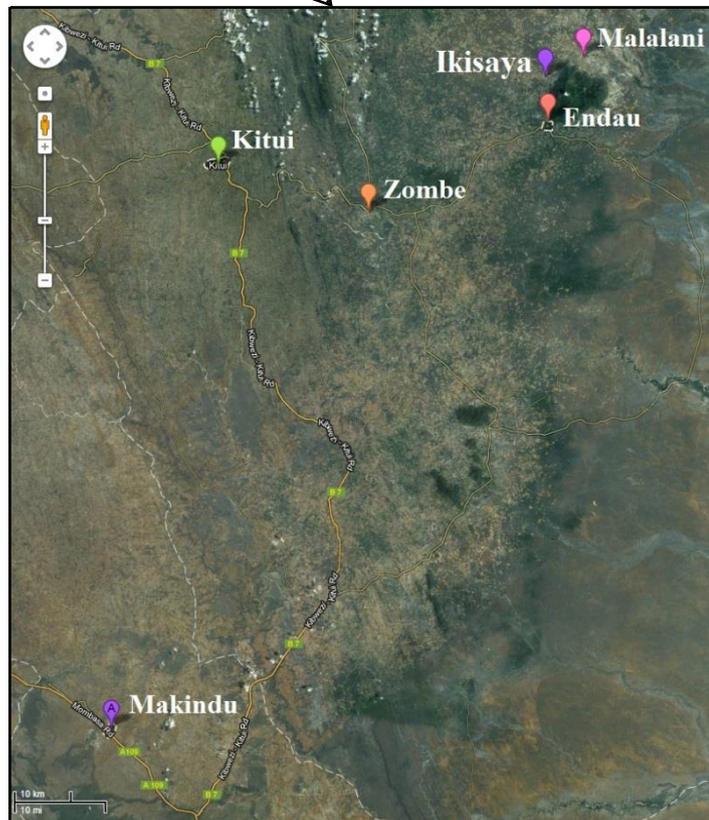
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¹ N.B.: All photos were taken by me, Marianne Mosberg, during my fieldwork in Ikisaya October 5th – November 5th 2012, except photo 4 which was taken by a fellow master student, Lan Marie Nguyen Berg, who was also doing fieldwork in Ikisaya in October-November 2012.

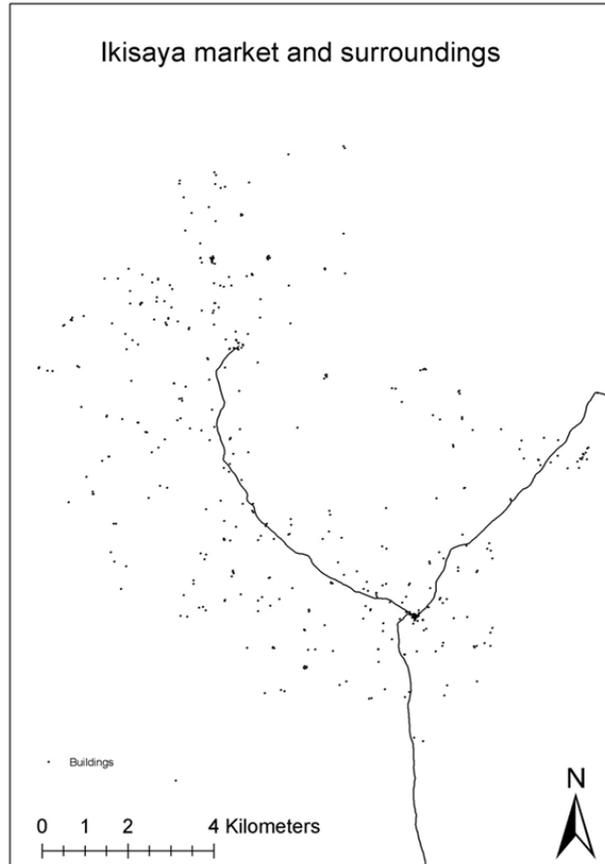
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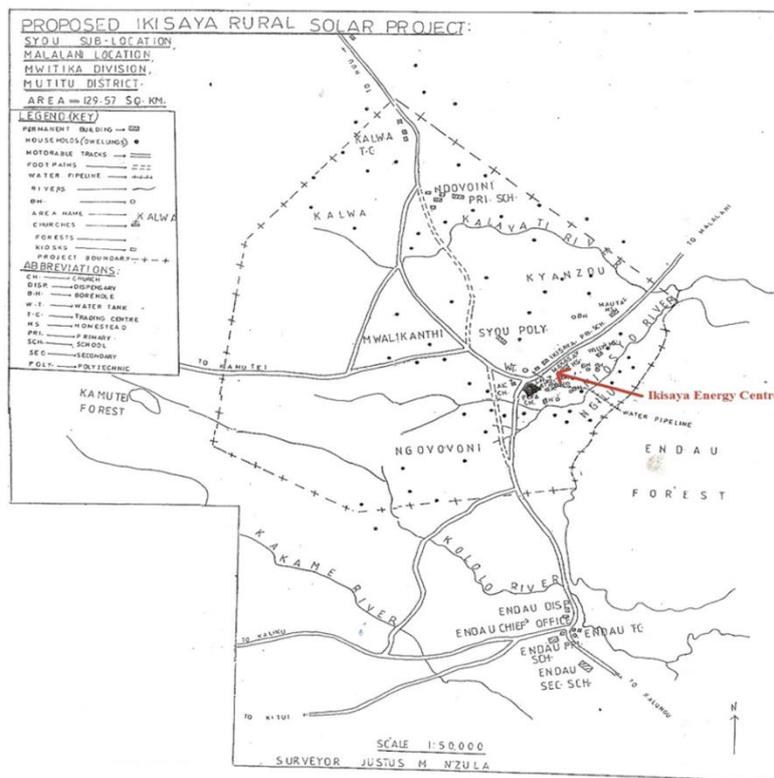
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Map 4: Map of Ikisaya, indicating location of Ikisaya Energy Centre (produced by the Solar Transitions project).

Chapter 1: Introduction

Global energy use and supply contributed to 25, 9 percent of global anthropogenic greenhouse gas emissions in 2004. Fossil-fuel based energy production and consumption is thus the main driver of human-induced climate change (Barker et al. 2007). Yet, nearly 1, 3 billion people in the world lack access to electricity, the majority of which live in Asia and Sub-Saharan Africa. In Kenya alone, 82 percent of the population lacked access to electricity in 2010 (IEA 2012). Meeting the electricity demands of all these people by further exploiting non-renewable fossil-fuels would contribute to increasing concentrations of greenhouse gases in the atmosphere dramatically, and further exacerbate global warming. Replacing carbon-intensive electricity production with renewable energy is therefore considered to be an essential climate change mitigation strategy (Edenhofer et al. 2012). Solar energy is, according to the World Energy Outlook 2012, the fastest growing renewable energy technology in the world today (IEA 2012). The rapid growth in solar energy is caused by a combination of factors such as falling production costs, governmental subsidies and technological advances (Arvizu et al. 2011; IEA 2012).

Lack of electricity is generally considered to be a hindrance to development, and access to modern energy is perceived to be crucial for achieving the Millennium Development Goals (Acker & Kammen 1996; Birol & Brew-Hammond 2012). It is also increasingly being recognized that access to electricity can contribute to enhancing the adaptive capacity of populations that are vulnerable to climate change (Venema & Rehman 2007; Yadoo & Cruickshank 2012). Rural electrification can be achieved through either extending the grid network to rural areas, or through developing off-grid, also called decentralized, electrification systems (Yadoo & Cruickshank 2012). Grid extension to remote areas is generally very expensive, due to large distances and difficult terrain, and even if the grid is extended to remote areas, the consumers are often unable to afford connecting their household to the grid due to high connection costs. Decentralized electricity production and provision is therefore, in many cases, the best option to attain rural electrification in developing countries (Ahlborg & Hammar 2012; Mahapatra & Dasappa 2012; Yadoo & Cruickshank 2012).

Rural electrification based on decentralized renewable energy therefore has the potential to reconcile several concerns; providing access to electricity to remote and poor rural

populations, increasing their ability to cope with and adapt to climate change, whilst simultaneously reducing emissions of greenhouse gases from the energy sector.

Mitigation and adaptation were for a long time treated as separate responses to climate change, and mitigation originally received more attention than adaptation in international climate negotiations and policies (Cohen et al. 1998; Klein et al. 2005; Schipper 2009). However, the realization that; “because of the lag times in the global climate system, no mitigation effort, no matter how rigorous and relentless, is going to prevent climate change from happening in the next few decades”, has led to a greater awareness of the necessity of adaptation in the international community (Klein et al. 2005: 3). The Intergovernmental Panel on Climate Change (IPCC) (2007b: 12) claims that; “Even if the concentrations of all greenhouse gases and aerosols had been kept constant at year 2000 levels, a further warming of about 0.1°C per decade would be expected”. A recent focus of both climate change research and policy has therefore been on developing potential synergies between mitigation and adaptation. This interests stems from the desire to achieve win-win situations by implementing policies that both reduce the adverse effects of climate change as well as limiting greenhouse gas concentrations in the atmosphere (Klein et al. 2005).

However, responses to climate change can potentially have negative implications for social equity and environmental sustainability, both in the short term and in the longer term. It is therefore increasingly recognized that “not every response to climate change is a good one” (Eriksen et al. 2011). This realization has led to the introduction of the concept ‘Sustainable Adaptation’ (Eriksen et al. 2011). This concept reconciles the notion of adaptation with sustainability, maintaining that adaptation is sustainable when it does not compromise the ability of future generations to adapt to climate change (Brown 2011). Sustainable adaptation is defined by Eriksen et al. (2011: 8) as; “adaptation that contributes to socially and environmentally sustainable development pathways, including both social justice and environmental integrity”.

Hence, although decentralized renewable energy could potentially reconcile concerns for development, adaptation and mitigation of climate change, little is currently known about the wider implications of such strategies for social equity and environmental sustainability. This thesis will use a theoretical framework based on the sustainable adaptation concept to investigate the wider implications of a decentralized solar Energy Centre in Ikisaya on social equity and environmental sustainability.

This thesis employs a qualitative case study approach to investigate local solar energy supply and sustainable adaptation to climate variability and change in Ikisaya. Empirical data was collected during a fieldwork in Ikisaya from October 8th to November 5th, 2012. The data collection methods used during the fieldwork were qualitative interviews and observations. 50 semi-structured interviews with individual informants, 13 key informant interviews and one focus group interview with seven female participants were conducted. Information and documents provided by Ikisaya Energy Centre and the Solar Transitions research group has also been reviewed. The methodological approach is discussed comprehensively in chapter 4 of this thesis.

1.1 Thesis objective and research questions

The objective of this study is to examine if local supply of electricity from a decentralized solar Energy Centre can contribute to leading the village of Ikisaya on a development pathway that is socially and environmentally sustainable. This is of relevance to many other similar remote dryland areas. Renewable energy, such as solar energy, is currently being heavily promoted as a strategy to mitigate climate change through reducing emissions of greenhouse gases from the energy sector at the global level. As mentioned above, it is also being argued that renewable energy could contribute to adaptation to climate change, as access to modern energy is seen to have multiple developmental benefits. Renewable energy may therefore potentially contribute to environmentally and socially sustainable development pathways. The purpose of this research project is to explore if rural electrification based on decentralized renewable energy might be a viable strategy to employ in order to sustainably adapt to current variability and future changes in the climate.

This master thesis therefore addresses the following main research question;

Can local supply of solar energy contribute to sustainable adaptation to climate variability and change in rural Ikisaya, Kenya?

In order to answer this main research question, this thesis also explores two interrelated sub-questions;

- i) *How do climatic and societal factors, and people's responses to these, contribute to contextual vulnerability in Ikisaya?*

- ii) *How does the solar Energy Centre influence the vulnerability context in Ikisaya, and how do climatic and societal factors in turn affect the viability of the solar Energy Centre?*

The first part of the analysis, chapter 5, addresses the first sub-question, and investigates the vulnerability context in Ikisaya. Contextual vulnerability is here understood as a present state of inability to cope with and respond to climate variability and change, caused by multiple interacting conditions and processes. This chapter focuses on how interrelated climatic and societal factors, and people's responses to these, contribute to differential vulnerability in Ikisaya; making some more vulnerable than others.

The second part of the analysis, chapter 6, will explore the second sub-question. This chapter investigates the reciprocal relationship between the solar Energy Centre and contextual vulnerability in Ikisaya. Based on this investigation, the chapter will then answer the main research question of this thesis.

1.2 Defining key terms

This section defines some key terms used in this thesis, in order to clarify how these are understood and employed. Theoretical concepts, such as vulnerability, adaptation, poverty and development, is discussed and defined in chapter 3: the theoretical framework.

Weather and climate is sometimes used interchangeably, but they are not synonyms. *Weather* refers to phenomena such as precipitation, temperature, wind and cloudiness, that occur on a daily basis, while *climate* refers to average weather conditions that occur over a longer period of time, such as months or years (Basher & Briceño 2005; Raven et al. 2010). *Climate variability* and *climate change* also refer to different phenomena. Climate variability refers to observed inter-annual differences in climatic parameters within an average period, while climate change refers to longer-term changes in climatic parameters between averaging periods, (typically over at least 30 years), either in their mean values or in their variability (Ribot et al. 2009). Anthropogenic climate change is defined by the Intergovernmental Panel on Climate Change as; “a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods” (IPCC 2007a: 943). Accordingly, in this thesis the concept of climate change refers to longer-term changes in climatic parameters, caused by human-induced emissions of Greenhouse Gases (GHGs) and

alterations of land surface properties, while climate variability refers to inter-annual variations in the climate system.

Another important distinction concerns that of *energy* and *electricity*. The Oxford dictionary definition of energy is; “power derived from physical or chemical resources to provide light and heat or to work machines” (Pearsall 1999: 471), while electricity is defined as “a form of energy resulting from the existence of charged particles (such as electrons and protons), either statically as an accumulation of charge or dynamically as a current” (Pearsall 1999: 460). Renewable energy refers in turn to energy derived from natural sources that are not depleted when used (Pearsall 1999), such as solar, tidal, geothermal, wind or hydropower. Solar energy can be converted to electricity through two processes. The first process involves converting energy from the sun to electricity through photovoltaic (PV) solar cells. The PV cells are normally arranged on panels, which absorbs the sunlight and generate electricity (Raven et al. 2010). The second process involves using solar thermal energy “in a concentrating solar power (CSP) plant to produce high-temperature heat, which is then converted to electricity via a heat engine and generator” (Arvizu et al. 2011: 337). This thesis investigates a decentralized energy centre in Ikisaya that uses solar PV technology to convert sunlight into electricity. For the purpose of this thesis, the generic term solar energy is used to refer to electricity generated through PV solar cells, which powers electrical devices such as TV and portable lanterns.

Livelihood is another key term used in this thesis. Livelihoods are commonly defined as “the capabilities, assets (stores, resources, claims and access) and activities required for a means of living” (Chambers & Conway 1992: 7). A livelihood is hence a way of earning a living. Formal employment comprises one form of livelihood, but it is not the only one. As emphasized by Chambers (1995), poor people normally rely on a variety of livelihoods, which are based on multiple activities and sources of food and income. This thesis employs the concept of livelihoods to investigate how people in Ikisaya earn a living by engaging in a number of activities, and explores how the Energy Centre influences livelihoods.

1.3 Thesis outline

The thesis is structured in seven chapters. This first chapter has introduced the topic addressed in the thesis and presented the thesis objective and research questions. The second chapter presents *background* information about the case study. The chapter first describes contextual features of the study area Ikisaya, and then outlines the history of establishing Ikisaya Energy Centre, the management structure of the centre, and the services offered by the centre. The third chapter presents what theoretical aspects the case study address and outlines the *theoretical framework* used to analyze empirical findings of my research and answer the research questions. The chapter presents previous research relevant to distinguish what is already known about the topic of this thesis, and argues how this thesis contributes to new knowledge by filling a ‘research gap’.

The fourth chapter, the *methodological approach*, describes how data for this thesis has been gathered and analyzed. The chapter presents and discusses the research design, data collection and analysis methods employed in this thesis, and offer a justification for methodological choices. The chapter also discusses how principles of research ethics were followed during fieldwork and in the presentation of findings in this thesis, and deliberate how I chose to solve ethical dilemmas. Finally, the chapter assesses the quality of this research, and points to strengths and limitations.

Chapter 5; *Contextual vulnerability in Ikisaya*, is the first of two analytical chapters. The chapter presents empirical findings from my fieldwork in Ikisaya, and answers the first subordinate research question. The main climatic and societal factors that contribute to vulnerability in Ikisaya are presented and discussed first. The chapter then presents the main strategies people employ to cope with the factors identified in the first part; their coping strategies, and strategies employed to adapt to longer term climatic and societal changes; their adaptation measures. The purpose of this chapter is to present and discuss the role climatic and societal factors and people’s responses to these plays in shaping the vulnerability context in Ikisaya. The chapter argues that climatic and societal factors cause differential vulnerability within the community; some are more vulnerable to climate variability and change than others.

Chapter 6; *solar energy and sustainable adaptation in Ikisaya*, is the second part of the analysis. The chapter addresses the second subordinate research question, as well as the main

research question, by analyzing empirical data gathered during fieldwork. The chapter emphasizes that there is a reciprocal relationship between contextual vulnerability and the local solar energy supply from Ikisaya Energy Centre. The chapter thus first deliberates on how Ikisaya Energy Centre and the services offered by the centre influence the vulnerability context and differential vulnerability in the community. Then the chapter discusses how contextual vulnerability in turn influences the viability of the Energy Centre. How the Energy Centre may contribute directly or indirectly to sustainable adaptation, as is the main research question of this thesis, is then discussed. The chapter concludes that supply of solar energy in a rural community might exacerbate differential vulnerability, and contribute to sustainable adaptation for some, but not necessarily everyone.

The final chapter, the *conclusion*, discusses how this research complements previous research and provides new knowledge on the relationship between local solar energy supply and sustainable adaptation.

Chapter 2: Background

This master thesis studies the relationship between local solar energy supply and sustainable adaptation by investigating a solar Energy Centre offering various pay-per-use services in Ikisaya, Kenya. Fieldwork for this thesis was conducted in Ikisaya between October 8th and November 5th, 2012. The first part of this chapter briefly introduces Ikisaya, the study area of this thesis. The second part presents the decentralized solar Energy Centre in Ikisaya. The purpose of this chapter is to provide necessary background information regarding the case study investigated in this thesis.

2.1 Ikisaya, Kenya

The rural area of Ikisaya is located about 300 kilometers north-east of Nairobi (see Map 1 on page xiii). The area is situated on dry plains at about 500 meters above sea level (masl) (Eriksen & Lind 2009). The permanently settled people in Ikisaya belong to the ethnic group ‘Kamba’, the fifth-largest ethnic group in Kenya (Miller, A. N. et al. 2009). The Kamba people speak the language Kikamba, but most people also know Kiswahili, and those who have higher education speak English as well.

The name ‘Ikisaya’ is used somewhat confusingly in the area. Some use the name Ikisaya to refer to a specific market area (where Ikisaya primary school and Ikisaya Energy Centre is located, see map 4 on page xiv), others use the name Ikisaya to refer to the conglomeration of six smaller villages; Ngovovoni, Ngiluni, Kalwa, Ndovoini, Kyanzou and Mwalikanthi. This conglomeration is administratively referred to as a ‘sub-location’. A ‘sub-location’ is the lowest administrative level in Kenya. The formal name of this sub-location is however *Syou*, but according to the chief of the sub-location (the sub-chief), the name Ikisaya is increasingly being used instead of *Syou* locally. I will in this thesis use the name Ikisaya to refer to the sub-location of *Syou*, because this is how it is most commonly used locally. Ikisaya (or *Syou*) sub-location belongs to Malalani location, Mwitika division and Mutito district in Kitui County.

Ikisaya is spread out over an area covering about 40km², and has according to the sub-chief a population of approximately 3000 people, divided on 377 households. The area is therefore

sparsely populated and has a scattered population pattern (see settlement pattern on Map 3, page xiv).

Ikisaya has two public primary schools; Ikisaya primary school and Ndovoini primary school. The two primary schools have about 500 enrolled pupils in total (Kirubi 2011). There are no secondary schools within Ikisaya; the closest are located in Endau and Malalani (see location of Endau and Malalani on map 2 on page xiii). Until recently, there was a polytechnic school in Ikisaya, but this school closed down in 2012. There are about 12-15 small shops and restaurants in Ikisaya, mainly located at the so-called 'market area' (Ulsrud 2013). The national electricity grid has not been extended to Ikisaya yet.

The majority of the people in Ikisaya are agro-pastoralists who normally grow maize, sorghum, cowpeas, greengrams and millet, and/or keep goats, cattle and poultry. Very few people living in the community have formal employment. Those who do have employment within Ikisaya are the teachers at the local primary schools, the sub-chief and the staff at the newly opened Ikisaya Energy Centre. The sub-chief is employed by the government, and is responsible for being the link between the government and the local community and administering governmental resources allocated to the sub-location. The main livelihoods of the majority of people in the community are thus farming and livestock keeping, while some few have formal employment, some own restaurants and shops, and a few rely only on informal casual work or remittances from family members living outside Ikisaya.

2.2 Ikisaya Energy Centre



Photo 1: Ikisaya Energy Centre (Photo by Marianne Mosberg, 2012).

Ikisaya Energy Centre is a decentralized solar Energy Centre that opened for business on March 20th, 2012. The centre was initiated and established by the research project “Village scale solar systems for development: Transfer of social and technological innovations between India and Kenya”, short named ‘Solar Transitions’. The research project was led by the Department of Sociology and Human Geography at the University of Oslo, with Noragric as one of several project partners. The project was funded by the Research Council of Norway, and lasted from the 1st of April 2009 to the 1st of April 2013. The project investigated “ways to implement and use solar energy in local communities in developing countries that are viable in the long run and contribute to social and economic development and climate adaptation” (UiO 2012). The project is a collaborative action-research project. The project process had two main parts. First, the research team studied the implementation of community solar power plants on the Sunderban Islands in India. The second part of the project consisted of using lessons and knowledge acquired from the case in India and other local solar electrification projects to develop a local solar Energy Centre in rural Kenya. The aim of the Ikisaya Energy Centre ‘pilot project’ was to develop a model of local solar energy supply that benefits people, including poor and marginalized groups, and contribute to climate adaptation and poverty reduction (UiO 2012).

The process of developing the decentralized, off-grid, solar Energy Centre in Ikisaya was quite long; it took two and a half years of research and planning before the Energy Centre was finished and could finally open on March 20th, 2012². The long process was also caused by difficulties with regards to raising money for the technical equipment. Funding for the equipment was provided by the Norwegian research council and the different project partners. The process of establishing the Energy Centre has been iterative and involved continuous communication between the Solar Transitions project team and the local community. The plans therefore went through significant alterations throughout the process. The purpose of this has been to ensure that the centre is context sensitive; that it suits local conditions, appropriately address the needs of community members, and ensure that the centre is viable on a long term basis and possibly capable of self-expanding (Ulsrud 2013)³.

Ikisaya Energy Centre is managed by a Community Based Organization (CBO), called ‘the Ikisaya Energy Group’. Membership in the CBO is restricted to local inhabitants in Ikisaya (Syou) sub-location only. The membership fee is 200 KSh⁴. The CBO was set up in May 2011, and had 199 members in October 2012. The CBO is led by a board, which is elected by the members. Only members of the CBO can be elected to the board. The board also has a group of executives; a chairperson, vice-chairperson, treasurer, secretary and assistant secretary. The Solar Transitions research team advised the Ikisaya Energy Group CBO to establish a temporary board, an interim committee, that would manage the Energy Centre before and right after the centre opened. The election for the interim committee was held on May 25th, 2011. 16 temporary board members were elected, including 5 executives. The first actual election for the board would then take place a few months after the Energy Centre had opened, as the community had started getting accustomed to the centre and more people had become members of the CBO. The board of the CBO is responsible for hiring staff to work at the Energy Centre. Five staff members, one female and four male, were hired in 2012; a manager, an IT clerk, a technician, an evening attendant, and a part-time accountant. The number of staff members was however later reduced from five to four.

The Energy Centre has Solar Photovoltaic (PV) panels on the roof, and batteries inside. The centre has four rooms; a multi-purpose room with a TV and DVD-player; an IT-room with a computer and a multifunction printer; a management room with batteries and control units

² The following sections about the Solar Transitions research project and Ikisaya Energy Centre is based on information provided by the Solar Transitions research group and Ikisaya Energy Centre.

³ Kirsten Ulsrud is the project leader of the Solar Transitions research project.

that also works as the manager’s office; and a ‘charging room’ that offers charging services. Ikisaya Energy Centre offers a variety of pay-per-use services;

Services offered by Ikisaya Energy Centre and tariffs:

- ❖ **Rental of portable LED-lanterns:**
Deposit 200⁵ KSh per lantern, Charging 20 KSh (must be charged every other day)
- ❖ **Cellphone charging:** 20 KSh
- ❖ **Computer services:**
 - **Typing:** 30 KSh per page
 - **Printing:** 20 KSh per page
 - **Photocopying:** 10 KSh per page, 15 KSh for ID’s
 - **Scanning:** 15 KSh
 - **Laptop charging:** 350 KSh
- ❖ **TV/Video viewing:** News 5 KSh, Movies 10 KSh, Football 20 KSh
- ❖ **Hire of multipurpose room** (with light and TV/Video): 100 KSh – 500 KSh
- ❖ **Haircutting (Kinyozi):** Adults 30 KSh, Kids 15-20 KSh
- ❖ **Retail outlet:**
 - **Sale of solar lanterns and small Solar Home Systems (SHS) (Powapacks):**
3,500 KSh – 15,000 KSh

Table 1: Services offered by Ikisaya Energy Centre and tariffs as of May, 2012 (Source: Ikisaya Energy Centre/Solar Transitions).

The centre can charge up to 60 cellphones per day; up to 30 at the same time. News is shown in the TV room at 1pm and 7pm every day, unless the room has been hired for other purposes. Customers can also request for other TV shows, such as football matches or movies. The haircutting service (*Kinyozi*) was not initially planned to be offered by the Energy Centre, but the staff saw the opportunity of opening a barbershop using energy from the solar PV system, and set up the barbershop in august 2012. The centre also has a retail outlet, where they sell different Solar Home System sets or individual components. These can be purchased with a one-time payment or in installments.

⁴ 200 KSh = 3 USD (Exchange rate 0.0151, per 07.05.13)

⁵ Note that 1 Kenyan Shilling (KSh) = 0.0151 USD (per 07.05.13).

The centre also rents out portable solar lanterns. The lanterns must be charged every other day to avoid deep discharging of the batteries. Complete discharge makes it more difficult to recharge the lanterns and might be harmful for the batteries in the lanterns. The lanterns have three settings; bright, normal and economy mode. The lantern can provide light for 4 hours in bright mode, 7 hours in normal mode and about 10 hours in the economy mode. It takes around 5-6 hours to recharge the lantern on a sunny day. Therefore, the lanterns have to be



Photo 2: Portable solar lanterns rented out at Ikisaya Energy Centre.

delivered to the Energy Centre in the morning, and collected in the afternoon. If a person does not deliver the lantern after two nights, the person is given a fine of 10 KSh for each additional day.

Another change that has happened after the Energy Centre opened in March 2012 has been the establishment of three 'agents'. Ikisaya Energy Centre first started renting out portable lanterns only at the centre in Ikisaya, but in June/July 2012 they set up three additional agents where lanterns were rented out. These

were located in Endau, Kalwa and Malalani. The purpose of establishing these agents was to bring the lanterns closer to people living far from the Energy Centre. However, the agent in Kalwa was in February 2013 discontinued due to low revenues. As of May 6th 2013, there are 63 lanterns at the Energy Centre in Ikisaya, 29 lanterns at the agent in Malalani, and approximately 54 lanterns in Endau (Ulsrud, personal communication, 06.05.12).

The Energy Centre needs to generate approximately 50,000 KSh of revenue per month to cover operational expenses such as salaries for staff, commission for the agents, maintenance and to save for replacement of batteries. The centre should save 21,300 KSh per month for the batteries, and monthly salary expenses are currently 22,000 KSh. Additional operational costs fluctuates somewhat from month to month. Any surplus generated by the Energy Centre that

Chapter 3: Theoretical framework

This thesis examines the ways the Energy Centre and the services offered by the centre can contribute to sustainable adaptation to climate variability and change in Ikisaya. As presented in the introductory chapter, the main research question of this thesis is; *Can local supply of solar energy contribute to sustainable adaptation to climate variability and change in rural Ikisaya, Kenya?*

In order to answer this main research question, the thesis will address two related sub-questions;

- i) *How do climatic and societal factors, and people's responses to these, contribute to contextual vulnerability in Ikisaya?*
- ii) *How does the solar Energy Centre influence the vulnerability context in Ikisaya, and how do climatic and societal factors in turn affect the viability of the solar Energy Centre?*

I will use the concept of sustainable adaptation as a theoretical framework to analyze empirical findings and answer these research questions. This chapter will review relevant theories on vulnerability, poverty, adaptation and development, in order to elaborate how sustainable adaptation is understood. A particular focus will be on placed on the concept of contextual vulnerability, because recognition of the vulnerability context is a key element of sustainable adaptation. The theoretical framework of this thesis also draws on the socio-technical systems approach, which involves recognizing the 'social embeddedness' of technology, to investigate the consequences of solar energy for sustainable adaptation. Previous relevant research on the relationship between rural electrification and development, solar energy and socio-economic impacts, and decentralized renewable energy and adaptation to climate change will then be reviewed towards the end of this chapter.

3.1 Sustainable adaptation

Sustainable adaptation to climate change is defined by Eriksen et al. (2011: 8) as "adaptation that contributes to socially and environmentally sustainable development pathways, including both social justice and environmental integrity". While only introduced recently, it builds on decades of multidisciplinary climate change research and theoretical debates on vulnerability

and adaptation, as well as debates on development and its linkages to climate change. It is thus important to understand ‘sustainable adaptation’ in view of these debates. This chapter will outline how the concept of sustainable adaptation relates to different discourses and framings of the climate change issue, and different approaches to understanding ‘vulnerability’ and ‘adaptation’ to climate change. This chapter will also discuss how sustainable development relates to different discourses on ‘development’.

The concept of sustainable adaptation originates from social science research on climate change, and is part of a broader discourse that aims at linking vulnerability to climate change with notions of social and environmental sustainability (Brown 2011; Eriksen & Marin 2011). The concept emerged out of the realization that not all measures aimed at adapting to climate change have desirable outcomes, but might actually have (often unintended) negative impacts on both humans and the environment (Eriksen et al. 2011; Eriksen & Marin 2011). Sustainable adaptation thus addresses the problem referred to as ‘maladaptation’, defined by Barnett and O’Neill (2010: 211) as; “action taken ostensibly to avoid or reduce vulnerability to climate change that impacts adversely on, or increases the vulnerability of other systems, sectors or social groups”. The authors identifies five types of maladaptation to climate change: adaptation measures that increase emissions of greenhouse gases and thus exacerbate global warming; adaptation that disproportionately burden those who are already the most vulnerable; adaptation that have high opportunity costs; adaptation measures that reduce incentives to adapt; and adaptation that leads society on a path that limits the choices available to future generations.

Sustainable adaptation addresses these types of maladaptation, and maintains that adaptation should be environmentally and socially sustainable. The concept thus situates notions of vulnerability and adaptation to climate change within notions of sustainable development (Brown 2011). Adaptation requires consideration for both current and future generations; adaptation measures employed today must not compromise the ability of individuals and communities within the current generation and in future generations to adapt to climate change (Eriksen et al. 2011). A wider discussion of the relationship between sustainable adaptation and sustainable development will be presented in section 3.1.4.

Eriksen et al. (2011: 7) proposes four key normative principles that should guide adaptation to climate change in order to achieve social justice and environmental integrity;

Key Principles of Sustainable Adaptation	
1.	Recognize the context for vulnerability, including multiple stressors
2.	Acknowledge that different values and interests affect adaptation outcomes
3.	Integrate local knowledge into adaptation responses
4.	Consider potential feedbacks between local and global processes

Table 2: Key principles for sustainable adaptation (based on Eriksen et al. 2011).

The first principle asserts that adaptation strategies should recognize the context for vulnerability; the wider context of which climate change is experienced (Eriksen et al. 2011). Brown (2011: 26) emphasize that “there are no one-size-fits-all solutions” when it comes to adaptation to climate change; adaptation measures needs to be context-specific and designed to fit the specific context in which it is to be applied. This principle thus builds on a ‘contextual’ understanding of vulnerability (which will be discussed in greater detail in section 3.1.2). This understanding of vulnerability argues that a community is exposed to various types of stressors that coincide in a complex manner. Climate change is just one of such stressors (O'Brien et al. 2007). If an adaptation strategy does not recognize that the vulnerability of a community is caused by various types of stressors, the adaptation strategy will not successfully reduce the vulnerability of a community. The adaptation strategy needs to address other types of stressors in addition to climate variability and change, in order to make individuals and households able to maintain their well-being during difficult periods (Eriksen et al. 2011).

The second principle of sustainable adaptation acknowledges that differential interests and potential value conflicts might affect the outcome of the adaptation strategy. The principle hence asserts that adaptation strategies should “analyse and recognize different interests and potential value conflicts up front, and identify how these may influence outcomes” (Eriksen et al. 2011: 13). According to this principle, adaptation measures need to recognize that there exist different interests, values and power relations in a community that might affect the

outcomes of adaptation measures. An adaptation measure might exacerbate asymmetrical power relations; it might empower some people while at the same time disempower other people. The outcomes of adaptation might thus be differential; it might effectively reduce the vulnerability of some people in a community, while simultaneously increase the vulnerability of groups or communities elsewhere. The second principle thus “suggest the need to ensure that representation of groups that are vulnerable to climate variability and change is institutionalized in formal government or development processes” (Eriksen et al. 2011: 13). Adaptation efforts that are to be sustainable in the long run should ensure that asymmetrical power relations are not exacerbated, but rather alleviated, and must make sure that it does not serve the interests of one group while at the same time undermining the interest of other groups. Adaptation should preferably benefit all of the members in a community; not just some individuals.

The third principle of sustainable adaptation states that it is necessary to “integrate local knowledge into adaptation responses” (Eriksen et al. 2011: 13). Local communities often encompass a vast amount of traditional knowledge on ecosystem properties and environmental processes in their area that complements ‘scientific knowledge’. Although ‘scientific knowledge’ about environmental and climate processes is necessary when designing adaptation measures, this knowledge needs to be complemented with local knowledge to be successful. An adaptation measure that ignores local knowledge might fail, because the measure is not appropriate to the specific local conditions of that area. Eriksen et al. (2011: 13) argues that “over time, vulnerable people have developed responses to disasters based on their knowledge and understanding of the conditions and environment where they live”. For example, farmers and pastoralists have extensive knowledge about local environmental conditions and weather patterns; such as knowing which areas of their community that is the most drought- or flood-prone. An adaptation measure involving extending farmland into such areas in an effort to maximize agricultural productivity might accordingly fail. Local knowledge therefore needs to complement ‘scientific knowledge’ in order to ensure effectiveness and sustainability of the efforts.

Finally, the fourth principle of sustainable adaptation holds that sustainable adaptation needs to “consider potential feedbacks between local and global processes” (Eriksen et al. 2011: 14). As vulnerability is nested and interlinked in intricate ways, adaptation efforts in one location might increase vulnerability in other locations (Adger et al. 2009). Actions taken at the local level might have grave consequences for other localities, or for the entire globe. Adaptation

strategies that reduce vulnerability in the short term may also increase vulnerability in the long term. Eriksen et al. (2011: 15) provides a good example of an unsustainable adaptation strategy (also called maladaptation); the production of artificial snow in Norway as a response to deteriorating snow and ice conditions. The purpose of the artificial snow is to ensure that it is still possible to ski throughout the winter. The energy used to produce this snow and ice however lead to emissions of greenhouse gases, and thus exacerbate global warming and climate change. This adaptation strategy might therefore increase vulnerability in the longer term. Accordingly, when adapting to climate change, one must ensure that the efforts do not generate or increase vulnerability for someone else, and one must take into consideration possible long term effects.

The concept of sustainable development thus promotes an alternative development pathway that ensures social equity and environmental sustainability (Eriksen et al. 2011). In particular, the concept aims to challenge current, fossil-fuel based development pathways that are causing both environmental deterioration, and social inequality.

3.1.1 Framing the climate change issue

Climate change has been studied within a variety of natural science and social science disciplines, such as physics, biology, economy, political science, humanities, human geography and psychology. Academic disciplines approach the climate change issue in different ways; they address different questions, use different methods, and propose different solutions (Bjurström & Polk 2011). O'Brien et al. (2007) argue that one can distinguish between two distinct ways of framing the climate change issue in academic research. First, a scientific, natural science based framing, and second, a human-security framing. These framings are in turn products of different discourses on climate change. The type of framing used to address the climate change issue influence what type of knowledge that is produced, and what type of response to climate change is prioritized. These framings thus influence how both vulnerability and adaptation is understood (O'Brien et al. 2007).

The *scientific framing* of climate change builds on a 'biophysical discourse' on global environmental change that focuses on how human activities affect biophysical processes. The scientific framing considers climate change to be an environmental problem caused by human impact on the global climate system. Research within this framing focuses on measuring emissions of greenhouse gases and using various models to project future climate change and

predict potential impacts (O'Brien et al. 2007). Cohen et al. (1998) also argues that the biophysical, natural science based, framing of climate change reduce the problem to merely concern global atmospheric emissions, and excludes societal dimensions of the problem. The scientific framing thus draws a distinction between 'society' and 'nature', and put focus on the latter (O'Brien et al. 2007). The scientific framing of climate change is evident in for example the First and Second Assessment Reports of the IPCC (Cohen et al. 1998).

According to O'Brien et al. (2007), the *human-security framing*, on the other hand, builds on a 'critical discourse' that focus on how social, political and economic dimensions shape the processes, responses and outcomes of global environmental change. The human-security framing focuses on the relationship between societal dimensions and climate change, and considers climate change to be a transformative process that affects individuals and societies in different ways. This framing thus understands nature and society to be inseparably linked (O'Brien et al. 2007). The concept of 'human security' is defined by O'Brien et al. (2007: 76) "as occurring when and where individuals and communities have the options necessary to end, mitigate or adapt to risks to their human, environmental and social rights, and have the capacity and freedom to exercise these options".

The concept of 'sustainable adaptation' can be placed within the human-security framing of climate change, as it emphasize a mutual relationship between nature and society, environment and development, and argues that adaptation to climate change should not only focus on biophysical changes, but multiple processes of societal and environmental change (Eriksen et al. 2011; Eriksen & O'Brien 2007).

3.1.2 Vulnerability to climate change

The sustainable adaptation approach places great emphasis on reducing vulnerability as part of adaptation. The concept of 'vulnerability' to climate change has however been defined and understood in a myriad of different ways throughout the last few decades, and various researchers have tried to categorize the numerous approaches to understanding the concept in different ways. Approaches to understanding vulnerability are also related to framings of climate change issues, described in the section above. For example, Brooks (2003) distinguishes between 'biophysical' and 'social' vulnerability. The *biophysical vulnerability approach* "is concerned with the ultimate impacts of a hazard event, and is often viewed in terms of the amount of damage experienced by a system as a result of an encounter with a

hazard” (Brooks 2003: 4). This approach studies vulnerability by assessing various indicators of outcome. The biophysical understanding of vulnerability is consistent with the scientific framing of climate change. The *social vulnerability approach* on the other hand, view vulnerability as a state, an inherent property of a system, that make the system vulnerable to hazards such as climate change (Brooks 2003). This social understanding of vulnerability is thus, more or less, consistent with the human-security framing of climate change.

Another categorization of approaches to the assessment of vulnerability to climate change is provided by Kelly and Adger (2000). They distinguish between ‘end-point’ and ‘starting-point’ approaches. The *end-point approach* assesses vulnerability based on estimates of potential climate change and adaptive responses. “The assessment of vulnerability is the end point of a sequence of analyses beginning with projections of future emissions trends, moving on to the development of climate scenarios, thence to biophysical impact studies and the identification of adaptive options. At the final stage, any residual consequences define levels of vulnerability” (Kelly & Adger 2000: 327). Kelly and Adger (2000) exemplifies the end-point approach by referring to the definition of vulnerability in the Second Assessment Report of the IPCC; “*Vulnerability* defines the extent to which climate change may damage or harm a system. It depends not only on a system's sensitivity but also on its ability to adapt to new climatic conditions” (Watson et al. 1996). This end-point approach to vulnerability belongs more or less to a scientific framing of climate change.

Kelly and Adger (2000) use the analogy of ‘the wounded soldier’ to explain the *starting-point approach*. A soldier that is already wounded, lying down on a battlefield, will be at risk of further attacks. The starting-point approach thus focuses on the existing state of vulnerability. “The ‘wounded soldier’ approach concentrates attention to the socio-economic and political context within which the impact process takes place, a context that may well determine vulnerability not only to climate stress but also to other forms of environmental and societal pressure” (Kelly & Adger 2000: 329). The starting point approach to vulnerability is in turn consistent with the human-security framing of climate change.

O'Brien et al. (2007) builds on this discussion of end-point and starting-point approaches to vulnerability, and categorizes interpretations of vulnerability as either ‘outcome vulnerability’ or ‘contextual vulnerability’. *Outcome vulnerability* is defined here as the “linear result of the projected impacts of climate change on a particular exposure unit (which can be either biophysical or social), offset by adaptation measures” (O'Brien et al. 2007: 75). This approach

interprets vulnerability as the negative outcome on an exposure unit attributed to climate change, mediated by responses. According to this approach, reducing vulnerability involves reducing the negative outcomes by mitigating or adapting to climate change. This approach is consistent with biophysical vulnerability and starting-point vulnerability. O'Brien et al. (2007) explicitly position the outcome vulnerability approach within the scientific framing of climate change.

Consistent with the starting-point and the social vulnerability approaches, *contextual vulnerability* focus on the context within which climate change is experienced, instead of the outcome of climate change. The contextual vulnerability approach “is based on a processual and multidimensional view of climate-society interactions. Both climate variability and change are considered to occur in the context of political, institutional, economic and social structures and changes, which interact dynamically with contextual conditions associated with a particular ‘exposure unit’” (O'Brien et al. 2007: 76). Vulnerability is thus not only influenced by changing biophysical conditions, but also by contextual conditions. The contextual vulnerability approach is based on a human-security framing of climate change (O'Brien et al. 2007). O'Brien et al. (2007) illustrates the difference between the outcome and contextual interpretations of vulnerability in the following frameworks:

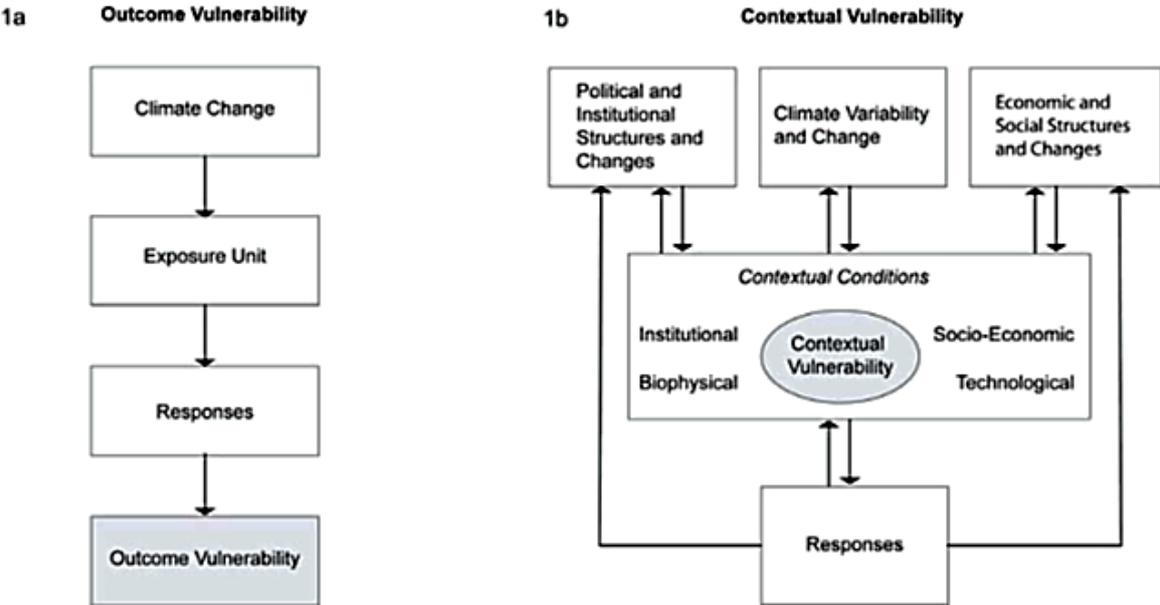


Figure 2: Frameworks depicting two interpretations of vulnerability to climate change: (1a) outcome vulnerability; (1b) contextual vulnerability (O'Brien et al. 2007: 75).

Contextual vulnerability can therefore be understood as a present inability to cope with and respond to climate variability and change. This inability is caused by multiple interacting contextual conditions and processes. According to this approach, reducing vulnerability requires “altering the context in which climate change occurs, so that individuals and groups can better respond to changing conditions” (O'Brien et al. 2007:76). Increasing the ability to cope with current climate variability and adapt to climate change is thus an integral part of reducing contextual vulnerability.

‘Multiple stressors’ is a key focus of contextual vulnerability, and hence a focus of sustainable adaptation. The multiple stressors concept maintains that vulnerability to climate change is “a state, generated not just by climate change, but by multiple processes and stressors” (O'Brien et al. 2004: 12). Communities and individuals are accordingly exposed to multiple stressors that interact with each other in complex ways. A community normally experiences a combination of environmental, social, political, economic, and institutional stressors that together influence the vulnerability context. These stressors occur on different temporal and spatial scales that interact in a complex manner (Adger et al. 2009). Communities are thus exposed to stressors originating at the global and national level as well as the local level. O'Brien et al. (2009: 24) argues that “The key to understanding vulnerability is to identify where and how different stressors interact; thereby indicating that vulnerability can be used to draw attention to the effects of multiple stressors on people’s well-being and livelihoods”.

Another important issue related to vulnerability to climate variability and change concerns the fact that vulnerability is differential, relative and context-specific (Eriksen et al. 2008; Liverman 2001; Ribot et al. 2009; Tol et al. 2004). Individuals, groups, sectors, communities or countries are not equally vulnerable, or vulnerable in the same way. Some are more vulnerable than others. “Whether considered in relation to the location, sector, state, or social group, vulnerability is context-specific due to differences in the set of social and environmental conditions, as well as the set of stressors to which each are exposed” (Eriksen et al. 2008: 5). Vulnerability can differ between individuals within a household, between households within a community, between communities within a country and so forth. Vulnerability to climate variability and change is thus related to social inequity (Kasperson et al. 2001).

Adger (1999) differentiate between individual and collective vulnerability, to emphasize two different scales of what he refers to as social vulnerability. According to him, individual

vulnerability “is determined by access to resources and the diversity of income sources, as well as by social status of individuals or households within a community” (Adger 1999: 252). Collective vulnerability, on the other hand, refer to the vulnerability of a community or nation, and is determined by institutional and political factors, market structures, infrastructure, level of development, access to insurance schemes and formal and informal social security (Adger 1999). These two are interlinked; individuals are influenced by the factors that cause collective vulnerability, and communities are influenced by relative inequality, differential access to resources and so forth. Making a distinction between individual and collective vulnerability emphasize that even though factors such as lack of infrastructure and unequal trade relations might make a community in general vulnerable, that does not mean that everyone in that community are equally vulnerable. Internal inequality in a community might make some more vulnerable than others. Looking at individual vulnerability in addition to collective vulnerability, make it possible to investigate differential vulnerability. This thesis will thus look at how contextual, structural conditions contribute to vulnerability in Ikisaya, and how inequality in access to resources, access to decision making processes, power relations, and access to coping strategies cause differential individual vulnerability in the community.

3.1.2.1 Vulnerability and poverty linkages

Differential vulnerability and inequitable processes are closely related to poverty, another central focus of sustainable adaptation. Poor people are often referred to be the ‘most vulnerable’ to climate change, and the terms poverty and vulnerability are sometimes used interchangeably. However, poverty and vulnerability are not synonymous, and not all poor people are equally vulnerable to climate variability and change (Eriksen et al. 2007; Tol et al. 2004). Eriksen et al. (2007: 15) argues that “while many of the factors shaping poverty are similar to those shaping vulnerability, they are not the same, and some factors are specific to vulnerability”. Poor people do not represent a homogenous group of vulnerable people. Some people, even though they are poor, might have a greater ability to cope with and adapt to stressors such as climate change, than other poor people. Poverty can however contribute to vulnerability, and it is thus important that measures aimed at reducing vulnerability also address poverty.

‘Poverty’ is a contested concept with various definitions and techniques of measurement. The conventional definitions of poverty focus on economic deprivation, income poverty, while

other definitions of poverty assert that poverty is multidimensional. Poverty entails multiple deprivations, such as lack of access to food, health and education (Banik 2006). This multidimensional view of poverty is often associated with the work of Nobel Prize laureate Amartya Sen. Sen (1999) referred to poverty as ‘capability deprivation’. The capability approach asserts that people have basic capabilities that enable them to function and have freedom to live the life they desire. Poverty is thus deprivation of these capabilities to pursue desirable lives, for example lack of access to education, health care, income and so forth. The OECD/DAC endorses this multidimensional view of poverty, and asserts that “the concept of poverty includes different dimensions of deprivation. In general, it is the inability of people to meet economic, social and other standards of well-being” (OECD 2001: 37).

As explained previously, the concept of sustainable adaptation builds on the contextual vulnerability approach. Sustainable adaptation thus requires addressing the context in which climate change is experienced and recognizing that vulnerability is differential (Eriksen et al. 2011; Eriksen & O'Brien 2007). Sustainable adaptation should also address vulnerability reduction and poverty reduction simultaneously, by addressing the failure to secure well-being in the face of climate change. Adaptation measures should thus; “(1) reduce risks to current ways of securing well-being; (2) strengthen the adaptive capacity of the poor; and (3) address the causes of vulnerability among the poor” (Eriksen & O'Brien 2007: 324).

3.1.3 Responding to climate change: mitigating, coping and adapting

Vulnerability is inseparably linked to *responses* to climate variability and change. One can generally distinguish between three types of responses to climate change; mitigating, coping and adapting. *Mitigation* of climate change refers to measures that deal directly with the cause of climate change. The goal of mitigation is thus to reduce global warming and associated changes in the climate. This is achieved by reducing emissions of greenhouse gases and enhancing so-called ‘sinks’ (Klein et al. 2005; Watson et al. 1996). Mitigation is connected to vulnerability. Stabilizing concentrations of greenhouse gases in the atmosphere and avoiding dramatic human-induced changes in the climate will reduce climatic stress on already vulnerable communities or individuals.

Another response to climate change is simply *coping* with the consequences. This means that societies and individuals need to employ various short-term strategies to secure well-being in the face of changes in the climate. Such measures are referred to as ‘coping strategies’ in the

climate change literature (Davies 2009). “Coping strategies refer to activities aimed at obtaining food or income during times of stress, either through production or through formal and informal exchange and claims” (Eriksen et al. 2005: 291). For example during periods of drought, households often engage in alternative activities to secure food or income. These activities help the household to better cope with the drought. Such activities are however not only restricted to periods of stress, such as during drought, but they are often intensified in such instances (Eriksen 2005). Coping strategies are usually short-term oriented responses to current challenges.

Human populations continuously respond to natural variations in the climate and develop various strategies to secure well-being during difficult periods. “Given that climate variability is not new, people have been coping with it as long as there have been people” (Patt 2009: 79). However, the strategies used to respond to short-term climate variability might not be sufficient when faced with climate change. Coping with climate variability is thus not necessarily the same as adapting to climate change. It is therefore important to distinguish between the two types of responses; coping with or adapting to climate variability and change. These two terms are often used interchangeably, but “coping and adapting are two distinct processes” (Eriksen et al. 2005: 288). “Coping strategies are methods used by households to survive when confronted with unanticipated shocks and stressors whereas adaptation involves adjustments over the longer-term to enhance longer term livelihood security” (Lind & Eriksen 2005: 4).

The term ‘coping capacity’ is used to refer to the ability of people to employ alternative activities to secure food and income during periods of stress. Eriksen et al. (2008: 25) define coping capacity as “The ability to prepare for an anticipated event, respond to that event once it takes place, and recover from its effects, such as through accessing alternative sources of food and income when agriculture fails”. Coping capacity is inextricably linked to vulnerability to climate variability and change. People who have a low coping capacity will be vulnerable to various types of stressors, such as drought or floods, as they might be unable to access alternative sources of food or income.

A third response to climate change is *adaptation*. While mitigation addresses the source of climate change, adaptation addresses the consequences of climate change (Schipper 2009). In contrast to coping with short-term climate variability, adapting to climate variability and change requires longer-term adjustments. As with vulnerability, there are also numerous

definitions and approaches to the concept of adaptation to climate change. (Eriksen et al. 2011: 9) define adaptation as “a wide range of behavioural adjustments that households and institutions make (including practices, processes, legislation, regulations and incentives) to mandate or facilitate changes in socio-economic systems, aimed at reducing vulnerability to climatic variability and change”, while Adger et al. (2003: 192) define adaptation as “the adjustment of a system to moderate the impacts of climate change, to take advantages of new opportunities or to cope with the consequences”. In general, adaptation to climate change can be understood as measures employed to adjust to and accommodate changes in the climate, in order to reduce damaging effects on the well-being of human populations. Adapting to climate variability and change thus involves reducing vulnerability caused by multiple, interacting stressors.

In parallel to the term coping capacity, the capacity of people or communities to adapt to climate variability and change is referred to as their ‘adaptive capacity’. “Adaptive capacity is 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” (Burton et al. 2002: 150). Adaptive capacity is therefore an essential part of vulnerability. The capacity to cope with and adapt to climate variability and change is imperative in order for communities to reduce detrimental effects of climatic challenges.

Coping capacity and adaptive capacity is thus not necessarily the same, but they are interrelated. “The factors that shape capacity to cope on timescales of days, months and years, and hence, present-day vulnerability, may complement the factors that shape the ability to adapt over longer timescales” (Eriksen et al. 2005: 288). A community with a high coping capacity might therefore encompass a high adaptive capacity as well, as the community is able to prepare for, respond to and recover from disturbances such as climatic challenges in the short-term, and might therefore also be well equipped to prepare for and adapt to longer term changes in the climate. Nevertheless, coping with shocks and adapting to change are distinct processes, and a high ability to cope with present-day climatic challenges does not necessarily mean that a community has the capacity required to adapt to longer term changes.

The concept of adaptation to climate change was infrequently used before 1992, when it was referred to in the text of the United Nations Framework Convention on Climate Change (UNFCCC) (Schipper & Burton 2009). Burton et al. (2002) argues that adaptation research has evolved since the 1990’s. They refer to a ‘first generation’ and a ‘second generation’ of

adaptation research. The first generation spanned mainly from 1995 to 2001, followed by the second generation. The first generation of adaptation research focused on how to implement planned adaptation in view of projections of the impacts of climate change. This type of adaptation research was thus ‘scenario-driven’, in that it used models or scenarios of future climate change to guide adaptation. This focused attention on potential impacts, not on current vulnerability. Burton et al. (2002) points to the “Technical guidelines for assessing climate change impacts and adaptations” presented in the Second Assessment Report of the IPCC as representing this first generation of adaptation research. These guidelines propose to assess biophysical and socio-economic impacts based on climate change scenarios, and then evaluate potential adaptation strategies based on these potential impacts (Carter et al. 1996). Burton et al. (2002) argued that the second generation of adaptation research was just then starting, and they thus made recommendations on how this new generation of research should be designed. They emphasized that adaptation measures should be context-specific, and focus on the present. Adaptation measures should focus on current vulnerability, and address the economic, social, political and environmental factors that generate vulnerability.

Analogous to the ‘first generation’ of adaptation research, Klein et al. (2007) refers to the ‘traditional view of adaptation’. “The traditional view of adaptation tends to assume that a national government develops and implements technological adaptation measures (e.g., dams, early-warning systems, seeds and irrigation schemes) based on scientific knowledge of future climate conditions” (Klein et al. 2007). The traditional view of adaptation thus focuses on potential impacts of climate change, and develops measures aimed at moderating these impacts. Present vulnerability is neglected in this view of adaptation, and the adaptation measures being implemented might exacerbate differential vulnerability by reducing the vulnerability of some people whilst unintentionally increase others’ vulnerability. The adaptation measures prescribed within this traditional view of adaptation might thus actually be maladaptive (Klein et al. 2007).

Sustainable adaptation can be understood as part of the ‘second generation’ of adaptation research that challenges the traditional view of adaptation. Sustainable adaptation implies focusing on present contextual vulnerability. Adaptation measures should be context-specific, and lead to environmentally and socially sustainable development pathways. Sustainable adaptation also challenges the separation of mitigation and adaptation as different responses to climate change. As explained previously, adaptation measures that increase emissions of greenhouse gases are referred to as maladaptive, because they contribute to causing

anthropogenic climate change. Adaptation should thus also take into consideration mitigation, and limit emissions of greenhouse gases. What is needed, is alternative development pathways that both reduce vulnerability and contribute to environmental sustainability. This brings us to how sustainable adaptation relates to debates on theories of development.

3.1.4 Climate change and development

Climate change is widely considered to pose a threat to global development efforts (Brooks et al. 2009). However, anthropogenic climate change is also fundamentally caused by global development, such as economic growth and consumption patterns (Eriksen & Marin 2011). There is thus a somewhat ‘reciprocal’ or circular relationship between climate change and development (Munasinghe & Swart 2005). This section will outline very briefly the field of development theories and discourses, in order to identify how sustainable adaptation relates to these theories.

The concept of ‘development’ is disputed, and has spurred great international debates the last six decades. Various development theories have since the end of the Second World War attempted to define what development is, as well as prescribing how such development is to be achieved (Bull 2006). These development theories have influenced how the challenges of development have been approached by governments and aid organizations worldwide to this day. The first development theory, referred to as ‘Modernization theory’, emerged in the period after the Second World War. This theory regarded development to be synonymous with economic growth and industrialization, and argued that development was a linear process from an underdeveloped state to a developed state. The reason why some countries had not yet ‘developed’ was because they had not yet started to ‘climb’ the ladder of development. The modernization theorists further argued that if the underdeveloped countries imitated the development pathway pursued by the developed countries, they would gradually develop as well (Bull 2006; Potter et al. 2004). In order to spur development in underdeveloped countries, the developed countries needed to transfer capital and technology to the poor countries, in order to support a ‘big push’ towards industrialization (Bull 2006). Development aid from rich countries and multilateral organization was therefore seen as an important instrument in the pursuance of development. Further, the modernization theory emphasized the essential role of the state in the development process. The state should follow Keynesian policies, which emphasized state-led interventions to promote growth in a capitalist economic system (Brooks et al. 2009; Potter et al. 2004).

Modernization theory has been heavily criticized since its ‘golden era’ of the 1950’s, and various oppositional development theories have challenged the view of development demonstrated by modernization theorists since then (Bull & Bøås 2010). Yet, although theories on development have evolved since the post-World War II period, the modernization paradigm of progress and economic growth still retain a high level of influence in the international community, and is still somewhat influencing the activities of development agencies (Brooks et al. 2009). Bull and Bøås (2010) divides the field of development theory into four broad categories; (1) Theories on modernization and economic growth, (2) theories on dependency and underdevelopment, (3) theories focusing on structural adjustment and good governance, and finally, (4) theories that searched for alternatives to traditional views of development, such as feminism, human development and post-development. This last category of theories originated in the post-cold war period (Bull & Bøås 2010).

In the 1990s there was increasing unease about the overly ‘economistic’ and top-down approaches to development that had dominated the field for over thirty years. This led to the search for more adequate concepts of development, and measures of progress, than economic growth and industrialization – concepts that could capture how development affected the lives of individuals (Bull 2006: 45).

Amartya Sen was highly influential in these attempts to redefine development. Sen saw development to be the process of expanding the real freedom of the individual to pursue a life that the individual has reason to value (Sen 1999). Sen’s ideas influenced the concept of ‘human development’ endorsed in UNDP’s Human Development Report (Bull 2006). “Since its launch in 1990 the *Human Development Report* has defined human development as the process of enlarging people’s choices. The most critical ones are to lead a long and healthy life, to be educated and to enjoy a decent standard of living” (UNDP 1997: 15).

The ‘sustainable development’ approach also gained prominence in the field of development theory in the 1990s. The term sustainable development was introduced by the Brundtland Report in 1987, defined as; “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED 1987: 41). The report further states that “sustainable development is not a fixed state of harmony, but rather a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are made consistent with future as well as present needs” (WCED 1987: 17). The concept of sustainable development focused on the relationship between the environment and development, and tried

to reconcile considerations for development and poverty eradication with environmental protection. The ‘three pillars of sustainable development’ are thus economic development, social development and environmental protection (Chasek et al. 2010; Langhelle 2002). However, as Ruud (2006: 137) emphasizes; “the basis of the definition is *not* the environment, but humans and human needs”.

‘Sustainable development’ has later been understood and defined in a variety of ways (Blewitt 2008). Different approaches to sustainable development can generally be distinguished by the degree to which they primarily emphasize meeting the needs of humans today or in the future, and if they emphasize environmental protection over human needs and vice versa (Langhelle 2002). Adams (2009) divide different interpretations of sustainable development in mainstream (reformist) approaches and radical approaches. The *mainstream approach* to sustainable development generally focuses on reforming the existing development pathway in a more environmentally, socially and economically sustainable manner, rather than challenging it radically. The mainstream approach aims to reconcile economic growth with protection of the environment, and emphasize the use of appropriate technology to achieve continued growth (Adams 2009).

The mainstream approach can be considered to be consistent with a ‘*weak sustainability*’ paradigm. Weak sustainability refers to the notion that depletion of natural capital, such as a forest, can be compensation for by a surplus of human-made capital, such as infrastructure (Adams 2009; Ang & Van Passel 2012; Langhelle 2002). This weak sustainability notion argues that “sufficient technological progress can improve human well-being despite environmental damage” (Ang & Van Passel 2012: 253). The notion of weak sustainability can be understood as placing a greater emphasis on human needs today than in the future, and emphasize human needs over environmental protection. Weak sustainability, and the mainstream sustainable development approach, does not challenge the existing development pathway that contributes to climate change.

The *radical approach* to sustainable development on the other hand challenges the mainstream approach by arguing that the existing development pathway needs to be altered radically, not simply reformed. This approach challenges the notion that appropriate technology can bring about desired changes (Adams 2009). The radical approach can be considered to be consistent with a ‘*strong sustainability*’ paradigm, that argues that stocks of both natural and human-made capital should be held intact (Adams 2009). Strong

sustainability “involves changing current modes of development, questioning calls for continued economic growth and appealing for a less managerial approach to human-environment relations” (Eriksen et al. 2011: 9).

The notion of ‘sustainable adaptation’ differs from the reformist approach to sustainable development (Eriksen et al. 2011), and can instead be understood as a proponent of the notion of strong sustainability, in that it promotes alternative development pathways that contribute to environmental integrity and social justice.

3.1.5 Aid, NGOs and adaptation to climate change

Official Development Assistance (ODA)⁷ and development projects implemented by Non-Governmental Organizations (NGOs)⁸ might have an impact on vulnerability to climate change in the recipient community. This thesis will investigate how a solar Energy Centre in Ikisaya contributes to sustainable adaptation to climate variability and change. Although the centre is not really a ‘development aid’ project, the installation and equipment is funded by an external donor; the Solar Transitions research project. In order to study the relationship between this centre and sustainable adaptation, it is thus useful to review the relationship between development aid and adaptation in general.

Development aid is closely related to the development theories. As mentioned earlier, the modernization theory viewed aid from rich countries as an essential tool in the struggle to achieve development in poor countries. This period after the Second World War is therefore considered to be the start, or the ‘birth’, of modern development aid (Nustad 2006). Aid policies and practices have changed in a dynamic relationship with the dominant development theories since the 1950’s. Broadly speaking, there has been a shift from the traditional aid given in the form of huge infrastructure projects, such as dams or roads, to an approach that is rather “seeking on the one hand to control the receiving state and on the other to reach people directly through so-called NGOs” (Nustad 2006: 248).

⁷ ODA is defined by OECD/DAC as those flows to countries and territories and to multilateral development institutions which are provided by official agencies, including state and local governments, or by their executive agencies; is provided with the promotion of the economic development and welfare of developing countries as its main objective; and is concessional in character (at least 25 per cent as a grant) (OECD, 2008: *Is it ODA?* Factsheet. URL: <http://www.oecd.org/dac/stats/34086975.pdf>).

⁸ The term Non-Governmental Organizations (NGOs) refers to organizations that does not belong to any state, are non-profit in character and have been established in order to provide or pursue some kind of good (Borchgrevink 2006).

William Easterly (2009) distinguishes between two different approaches of aid; one ‘transformational’ and one ‘marginal’ approach. The transformational approach “aims at permanently raising the growth rate of the economy through a permanent increase in aid (often conditional on changes in aggregate policies or institutions)”, while the marginal approach “has the goal of solving a much more specific problem for a target group of beneficiaries (much smaller than the entire population of a country)” through implementing more specialized aid programs (Easterly 2009: 375). The aid provided by NGOs typically falls within the marginal approach. Easterly (2009: 439) argues that it seems like “the marginal approach to fix one problem at a time or to assist individual Africans to get better health and education has a suggestive track record of success, as well as indications of future potential”, while the large scale outside interventions of the transformational aid approach seem to have been less successful in achieving development in Africa. Axel Borchgrevink also claims that; “In terms of providing *basic services* – health, education, water, sanitation – to those in need of them, NGOs have undoubtedly played a significant role. NGOs have had a particularly significant impact on those groups not receiving such services from the state, for instance in remote rural areas” (Borchgrevink 2006: 269).

Aid, both in the form of Official Development Assistance (ODA) and NGO implemented development aid projects, has been widely criticized the last few decades. Some of the key challenges with NGO implemented development aid projects that has been emphasized, concerns the sustainability of aid projects, local ownership to the project and local participation. The challenge of sustainability of development aid projects concerns the difficulty of ensuring long-term benefits, especially after funding ends (Charlton 1995; Gibson et al. 2005). After a donor NGO withdraws and stops funding a project, the challenge for the local community is to maintain the benefits accrued from the project. For example, if an NGO funds installment of a water pump in a local community, the community might need to do maintenance and find solutions to repair the pump themselves. The challenge of local ownership concerns the degree to which a local community, the beneficiaries, feels ownership to the development project (Gibson et al. 2005). If the beneficiaries lack a feeling of ownership to the project, they might feel less able to influence the sustainability of the project. Sustainability and ownership is thus interrelated (Gibson et al. 2005). Aid critics have argued that without local ownership, “recipients do not make the kind of commitments needed to ensure the realization of the intended long-term results of donor assistance” (Gibson et al. 2005: 11). The beneficiaries should thus be involved in the planning and design of

development projects. This is in turn related to the challenge of local participation. Development projects implemented without local participation might not appropriately address the needs and concerns of the beneficiaries. However, as Kothari and Cooke (2001) points out, local participation in development projects might also be challenging. Local power relations might determine who is represented in the participation and whose needs are listened to.

These issues are especially relevant when it comes to vulnerability and adaptation to climate change. Development aid projects might influence the local vulnerability context in both positive and negative manners, and it is thus especially important to be sensitive to local conditions, ensure local participation from marginalized groups, and ensure ownership and sustainability, to avoid increasing differential vulnerability to climate change. Barnett (2008) argues that aid can influence local adaptive capacity in recipient communities or countries. He argues that for aid to enhance adaptive capacity, it needs to be participatory and involve all stakeholders, and it needs to be conducted in a transparent manner.

Several NGOs and development agencies, such as the Norwegian Church Aid⁹ and USAID¹⁰, are now involving adaptation to climate change in their development aid efforts. Klein et al. (2007) argues however that instead of incorporating adaptation to climate change into ongoing activities and plans of development aid institutions, adaptation should rather be ‘mainstreamed’ into development efforts in a comprehensive manner. “A mainstreamed adaptation strategy should include measures that address the underlying factors of vulnerability to climate change, particularly on a local scale” (Klein et al. 2007: 4).

3.1.6 Critique of the sustainable adaptation approach

Using sustainable adaptation as a theoretical framework is however not unproblematic. Brown (2011) argue in her article “Sustainable adaptation: An oxymoron?” that the concept of sustainable adaptation is fairly vague and can be interpreted in a variety of ways. It might thus be difficult to translate the concept into policy, and it can be used to legitimize current, unsustainable, policies and strategies. “Sustainable adaptation may be co-opted to support development-as-usual rather than more radical options which put social justice, equity and environmental sustainability at the core” (Brown 2011: 21). She further argues that

⁹ <http://www.kirkensnodhjelp.no/en/What-we-do/our-strategic-priorities/climate-justice/climate-change-adaptation/>

¹⁰ <http://www.usaid.gov/content/global-climate-change/global-climate-change-adaptation>

sustainable adaptation might fall into the same traps as the concept of sustainable development has. It is thus helpful to review the criticisms raised against the concept of ‘sustainable development’, as it was defined and promoted by the Brundtland Commission.

Sustainable development has also been criticized for being an oxymoron; it seeks to combine two contradictory concepts (Redclift 2005). Banerjee (2003) argued that sustainable development tries to reconcile the two incompatible goals of economic growth and environmental protection. Critics argue that the concept encourages continued economic growth and that it consequently enables ‘greenwashing’ of current strategies and development pathways, which are not really sustainable (Brown 2011). Sustainable development has also been widely criticized for being deliberately vague and therefore difficult to operationalize (Brown 2011; Kirkby et al. 1995; Ruud 2006). Sustainable development can thus be interpreted in almost any way one wants. The concept has also been criticized for being “delusional, in distracting attention away from meaningful, more profound change and the root causes of global inequities and environmental degradation” (Brown 2011: 21).

There is the risk that ‘sustainable adaptation’ might become another ‘buzzword’ in the international community just like sustainable development has been and to a certain degree still is. There is a possibility that the concept might be co-opted and used to ‘greenwash’ unsustainable adaptation policies implemented by governments and aid institutions. Nevertheless, I think the concept is an important contribution to both climate change research and policy. Adaptation has indeed become a ‘buzzword’ in the international community. However, projects implemented in the name of adaptation might actually have negative social and environmental consequences. The concept of sustainable adaptation focuses on the need to evaluate potential environmental and social consequences of adaptation policies and practices, before implementing them. The concept thus emphasize on the need to make sure that adaptation measures do not exacerbate differential vulnerability today or in the future.

3.2 Socio-technical systems approach

In addition to using the ‘sustainable adaptation’ theoretical framework, this thesis draws on a socio-technical research approach to study the impacts of solar energy provision and its relationship with sustainable adaptation in Ikisaya. Socio-technical research “emphasize the dynamics between technology and society and how they are mutually influencing and shaping each other” (Ulsrud et al. 2011: 2). Rohracher (2008) define energy systems as;

...socio-technical configurations where technologies, institutional arrangements (e.g. regulation, norms), social practices and actor constellations (such as user–producer relations and interactions, intermediary organisations, public authorities) mutually depend on each other, and are embedded into broader contexts of cultural values, socio-economic trends (globalisation, individualisation, etc.) (Rohracher 2008: 147).

A socio-technical system is therefore defined by Ulsrud et al. (2011: 4) as; “a configuration of heterogeneous technological and social elements, such as technical devices, organizational aspects, involved actors and social practices in the implementation and use, as well as competences linked to the technologies”. The socio-technical research approach pays attention to the so-called ‘social embeddedness’ of technology, that is, how technology is embedded in the social fabric of any given setting. Technology is influenced by social practices, values and institutional settings, and the long term viability of a technology “depends at least as much on the social and economic organization of such systems as on their technical configuration” (Ulsrud et al. 2011: 2). This approach allows for a holistic understanding of the dynamic relationship between technology and society, and is therefore useful when investigating how solar energy might contribute to sustainable adaptation to climate change.

3.3 Literature review

This section will outline and present previous research that has been done which is relevant to the topic of this thesis; local solar energy supply and sustainable adaptation to climate variability and change. This presentation is based on a review of academic literature from peer-reviewed journals and books. Published academic research on the relationship between solar energy and sustainable adaptation to climate variability and change is scant. Hence, little is known about how energy access may contribute to sustainable adaptation. This can be explained by the fact that the concept of ‘sustainable adaptation’ is fairly new, and studies employing this framework have not yet been published in peer-review journals or books. There is thus currently a ‘research gap’ in research on solar energy and sustainable adaptation, a gap that this thesis seeks to contribute to fill. However, numerous studies have investigated the relationship between rural electrification and development, and some have studied the socio-economic impacts of solar energy. I have just found three studies on the relationship between energy and adaptation to climate change.

3.3.1 Rural electrification and development

Development theories in the 1950s to 1970s considered rural electrification to be a catalyst, or precondition, for rural development. However, current development theories understand rural electrification to be a necessary, but not *sufficient* requirement for development, and development might rather lead the process of rural electrification than follow as a consequence (Kirubi et al. 2009; Venema & Rehman 2007). The traditional view on the relationship between energy and rural development emphasized the direct impact of energy on income-generation and economic growth, that is, they focused on the ‘productive uses’ of energy in rural contexts (Cabraal et al. 2005). However, this view has been challenged in recent years. Trends in the field of development theory has influenced how rural development is understood and pursued, and there has been a move away from seeing rural development as synonymous with economic growth, to a more holistic understanding of human development that includes issues such as health, education and gender inequality (Cabraal et al. 2005). It is now being emphasized that access to energy directly and indirectly can contribute to achieving the Millennium Development Goals (DFID 2002).

Cabraal et al. (2005: 118) therefore argue that studies on the impact of energy on rural development needs to take into consideration “not only the direct impact of energy on raising incomes, but also the indirect impacts that energy can have on education, health and gender issues”. Access to electricity in rural areas is therefore not necessarily sufficient to bring about ‘development’, but electricity might still have great positive impacts on the society, such as enhancing the freedom and well-being of the rural population.

Cabraal et al. (2005) outline in their article some potential impacts of rural energy (electricity) access on poverty, health, education and gender issues. When it comes to the first issue, energy and *poverty*, they argue that “energy services can help reduce poverty and raise incomes in a variety of ways” (Cabraal et al. 2005: 124), and they mention four such positive impacts of energy on poverty reduction in rural areas. The first is using electricity to power farm equipment or machines. This has many benefits on the rural poor, such as increasing productivity, increase areas for cultivation and saving human labor time (Cabraal et al. 2005). The second impact of access to energy on poverty concerns saving time and resources. “For example, the rural poor spend a considerable amount of time each day collecting firewood, dung, and water” (Cabraal et al. 2005: 124). Access to electricity might enable the rural poor to have modern stoves or water pumps, which would save their time spent on collecting

biomass or water, as well as reducing the time spent on cooking. The third impact concerns the importance of light; “If the rural poor had access to lighting, they could work in the evenings and nights” (Cabraal et al. 2005: 126). Access to light extends the possible working hours and might therefore increase incomes. A fourth impact of energy on poverty concerns access to modern Information and Communication Technologies (ICT), such as cell phones, TV and radio (Cabraal et al. 2005). ICT might enable rural poor to gain information about market prices, good farming practices or allow them to order agricultural inputs or products from nearby towns, which will increase the productivity on their farms, connect them to markets and “ensures that they receive better prices for their produce” (Cabraal et al. 2005: 126). ICT powered by electricity might therefore increase the incomes of rural poor.

Cabraal et al. (2005) further argue that energy might have a positive impact on *education* in rural areas. “Modern energy services can have a positive impact on the time children spend at school and also improve the quality of the schools and the teaching. Electricity also provides lighting for rural homes, which increases the number of hours children have to study” (Cabraal et al. 2005: 127). Electricity might thus extend the available hours that children have for studying both at home and at school, and electricity can power ICT services that can be used in the education. Cabraal et al. (2005: 132) argue that “there is fairly strong evidence that electricity is related to improvement in school attendance, literacy, and level of education, but this could be caused by the decision of educated households to adopt electricity as well”.

When it comes to the third issue, the impacts of energy on *health*, Cabraal et al. (2005) asserts that modern energy services might have both direct and indirect positive impacts on the health of rural populations. When it comes to the direct benefits of energy, they state that; “Modern energy services improve health service delivery, increase access to safe drinking water, provide clean fuels that reduce indoor pollution, and can make available various communication tools (e.g., radio, television, and the Internet), which can be utilized effectively against AIDS and other diseases” (Cabraal et al. 2005: 132). Electricity might be used for; light in health clinics, enabling the clinic to treat patients during the night; refrigerating vaccines; operating medical equipment; and power ICT services, allowing for communication between patients, health clinics and hospitals (Cabraal et al. 2005). Further, “Energy services also provide indirect impacts on improving health by increasing literacy, reducing malnutrition, and promoting women’s empowerment.” (Cabraal et al. 2005: 135). Increasing women’s literacy rates have been found to reduce child mortality, maternal

mortality and reduce the spread of HIV/AIDs, and electricity can reduce malnutrition by allowing storage of food in refrigerators and freezers in hot environments(Cabraal et al. 2005).

Finally, Cabraal et al. (2005) argues that access to modern energy can have a positive impact on *gender equality* and *women's empowerment*. Electricity might reduce the time women spend on cooking, and collecting water and biomass. “This additional time can have a dramatic effect on a woman’s level of education, economic opportunities, and involvement in community activities” (Cabraal et al. 2005: 136). Further, access to TV and radio might spread awareness of gender equality issues, increase the knowledge of women, and thus contribute to empowerment of women (Cabraal et al. 2005).

3.3.2 Solar energy and socio-economic impacts

Previous case studies regarding solar energy supply enrich the theories regarding rural electrification and development. This section will review some peer-reviewed articles on the socio-economic impacts of specifically solar energy supply. These are based on case studies in rural areas of Kenya, Bangladesh and Sri Lanka. Five of the case studies has investigated the impacts of Solar Home Systems (SHS) (Acker & Kammen 1996; Jacobson 2007; Laufer & Schäfer 2011; Mondal & Klein 2011; Wijayatunga & Attalage 2005), while one has explored the impacts of a Solar PV Mini-Grid system (Chakrabarti & Chakrabarti 2002). The solar PV electricity in the six case studies was used for light, charging cellphones, powering TV and radios. Not all these case studies identified the same socio-economic impacts, but for the purpose of this thesis, this section will summarize the main impacts presented in these six articles taken together.

One positive impact of solar energy reported in several of these studies was *extended working hours* and enabling activities to be done in the evening. Light from solar power enabled businesses, such as shops and restaurants, to keep longer opening hours. This increased their income. Women were also able to do domestic work in the evening. Another positive impact concerned *education*. The bright solar-powered light, compared to dim kerosene or firewood light, enabled children to do homework in the evening. This was found to have increased their educational performance. A third positive impact was access to *information* through cellphones and TV. Further, access to charging opportunities for cellphones enabled *communication*. This was found to have an especially positive benefit for those who had relatives living elsewhere. A fifth benefit was access to *entertainment*, through watching TV

or listening to radios. A sixth impact that was identified in some of the articles concerned *health* benefits and enhanced *safety*. The articles argue that kerosene lamps cause indoor pollution that is damaging to health, and they can cause fires or burns. Using solar powered light instead of kerosene lamps reduce these health hazards. Nighttime safety was also reported to have increased due to availability of electric light. Having light in the evening, TVs and radios were also found to increase *social gathering* in the evening. Families spent more time together and people visited each other more frequently during the evening. Another impact found in some of these case studies was that the solar energy had led to the establishment of some *new businesses*, such as offering cellphone charging to others. Finally, using SHS or electricity from solar mini-grids provide freedom from price fluctuations on kerosene, and some save money over time on using solar energy instead of kerosene for light.

To summarize, these were the main socio-economic benefits of solar energy identified in the six case study articles reviewed here;

- 1) *Extended working hours*
- 2) *Education*
- 3) *Information*
- 4) *Communication*
- 5) *Entertainment*
- 6) *Health and Safety*
- 7) *Social gathering*
- 8) *Some new businesses*
- 9) *Freedom from price fluctuations on kerosene*
- 10) *Some save money on not buying kerosene*

However, the articles by Acker and Kammen (1996), Wijayatunga and Attalage (2005), and Jacobson (2007) report that the poorest people could not afford to buy the SHS. Those who could afford were primarily those with a stable salary, such as doctors, nurses and teachers, and small business owners. Wijayatunga and Attalage (2005), Mondal and Klein (2011) and Jacobson (2007) also found that the SHS had not led to any significant increase in promoting new income generating activities. Jacobson therefore argues that;

Electric light from solar PV systems plays a minor role in supporting income generation activities in rural Kenya. Given the distribution of ownership of solar systems, nearly all of these productivity gains are captured by rural middle class families. As a result, the use of solar electricity appears to contribute – albeit in a very small way – to processes of differentiation and middle class formation (Jacobson 2007: 147).

Further, Laufer and Schäfer (2011) found that those shops and restaurant-owners who could not afford to buy SHS lost customers to those shops and restaurants who did have SHS. Their income was thus reduced, while those who already was affluent enough to buy SHS gained a higher income. Accordingly, it seems like those who are able to afford buying SHS benefit more than the poorest; those who cannot afford to buy it. It is therefore important to consider distributional aspects and consequences for inequality when assessing the effects of rural electrification on socio-economic development.

3.3.3 Decentralized renewable energy and adaptation to climate change

This section will briefly outline findings from three studies on the relationship between renewable energy and adaptation to climate change. Venema and Cisse (2004) studied how decentralized renewable energy (DRE) could serve the dual goal of contributing to both mitigation and adaptation to climate change. They investigated experiences with DRE projects in five developing countries, to study the potentials of DRE as both mitigative and adaptive responses. They found that the DRE projects increased adaptive capacity of local populations in the cases they studied, through allowing for income generating activities, reducing pressure on natural resources and improving living conditions. For example, they found that a solar PV project in Senegal improved health services by providing light during the night, improved access to information and knowledge through TV and radio, enabled refrigeration of food, improved education of children as they were able to study at night, reduced incidents of fire from kerosene accidents and enabling income generating activities, such as rice milling and production and sale of ice blocks. Venema and Cisse (2004) thus argued that DRE can both be a mitigative response, as renewable energy emits less greenhouse gases than fossil-fuel based energy production, and an adaptive response. They argue that through enhancing livelihood security, reducing health risks and reducing vulnerability to climate change, DRE can contribute to enhancing well-being, meeting the Millennium Development Goals, such as reducing poverty, and increasing adaptive capacity.

Vognild (2011) studied the relationship between solar energy and adaptation to climate change on Moushuni Island, India, in her master thesis. She found that; “there are several ways in which the electricity from the solar power plants has changed the lives of people on Moushuni, and some of these changes have contributed to strengthening the islanders’ adaptive capacity” (Vognild 2011: 105). Vognild argues in her thesis that access to electricity generated by solar power reduced vulnerability to climate change for people on the island by enabling diversification of income and thereby reducing their dependency on climate-sensitive agriculture. The solar energy was also found to be “improving health through limiting the number of disease bringing bugs in the food, through playing a significant role during child birth and possibly improving indoor air quality” (Vognild 2011: 102). She also found that longer working hours enabled by light increased the income of villagers, and this income strengthened their ability to secure well-being after extreme weather events, and thereby enhanced their adaptive capacity (Vognild 2011).

Gippner et al. (2013) studied the potentials of electrification based on microhydro installations to enhance adaptive capacity, in addition to offer mitigative benefits. They studied a microhydro project in Nepal, and found that the microhydro units improved income levels in the local community, equalized gender roles, enhanced access to information, improved education and reduced emigration. The microhydro electrification in general improved standards of living, and thus reduced vulnerability to climate change. Based on their findings, Gippner et al. (2013) provided with three recommendations to adaptation policy. First, they argued that community mobilization is important for adaptation measures such as microhydro electrification. Community participation in the design, implementation and operation of a project ensures that the project addresses the needs of the community appropriately; it reduces reliance on donors and eliminates dependency; and lead to empowerment of community members. Secondly, they argued that local capacity building is necessary. Training the users of the electricity on how to use the electricity was found to be important in the Nepal case. Thirdly, they emphasized the importance of comprehensiveness in adaptation projects. The microhydro project in Nepal focused on not just constructing dams to generate electricity, but it also targeted disadvantaged groups and invested in community education and income-generating skills. This created ownership to the project and ensured sustainability. The study by Gippner et al. (2013) does not however define how they understand the concepts of vulnerability, adaptation and adaptive capacity.

These studies have highlighted some potential linkages between decentralized renewable energy and adaptation to climate change. They have argued that access to electricity might increase incomes and diversify livelihoods, and thereby reduce dependence on climate-sensitive livelihoods; reduce pressure on natural resources; improve access to information and knowledge; improve health and promote gender equality. Arguably, however, these studies pay little or no attention to how electrification might influence *differential* vulnerability in a community. The benefits of rural electrification projects might be distributed unequally in a community, and might thus not reduce vulnerability, or increase adaptive capacity, for all the members of the community. I found this important perspective to be lacking in these studies. Using the sustainable adaptation perspective would increase the understanding of how these renewable energy projects influence social dynamics and differential vulnerability, and thus if the adaptation strategy can contribute to socially sustainable development pathways in addition to environmentally sustainable development.

3.4 Summary

The theories, concepts and findings from previous studies presented here are used to guide the analysis of this case study. To summarize, the concept of sustainable adaptation argues that adaptation needs to contribute to socially and environmentally sustainable pathways. The four principles of sustainable adaptation holds that adaptation needs to; recognize the context for vulnerability, including multiple stressors; acknowledge that different values and interests affect adaptation outcomes; integrate local knowledge into adaptation responses and consider potential feedbacks between local and global processes (Eriksen et al. 2011). Sustainable adaptation challenges the traditional view of adaptation, which prescribes measures aimed at adjusting to scientifically projected future changes in the climate, while neglecting the present causes of vulnerability. Such measures might be maladaptive. Adaptation that does not address underlying causes of vulnerability will not necessarily lead to environmental and social sustainability.

Sustainable adaptation builds on a contextual understanding of vulnerability, which emphasize that vulnerability is a present and dynamic state of inability to cope with and respond to climatic stress. This inability is caused by multiple social and environmental conditions and processes. Reducing contextual vulnerability involves altering this context, and increasing coping and adaptive capacity. Further, vulnerability to climate change is differential; some are more vulnerable than others. Sustainable adaptation tries to reconcile

adaptation and mitigation as responses to climate change. Adaptation needs to both reduce emissions to greenhouse gases, to prevent exacerbating global warming, and reduce vulnerability, to avoid detrimental effects of climate change on human populations. Switching from non-renewable energy production to renewable sources of energy is an important mitigative measure. Decentralized renewable energy could also potentially contribute to sustainable adaptation, by reducing current vulnerability and enhancing adaptive capacity.

This thesis uses the sustainable adaptation theoretical framework to investigate if solar energy can contribute to sustainable adaptation to climate variability and change by reducing contextual vulnerability and enhancing coping and adaptive capacity. The first part of the analysis in this thesis, chapter 5, thus investigates how climatic and societal factors, and people's responses to these, contribute to contextual vulnerability in Ikisaya. The analysis focuses on climatic, environmental, economic, social and cultural, political and infrastructural factors, and investigates how these contribute to vulnerability. Vulnerability is in this thesis understood as a present inability to respond to and cope with climatic stress. This inability is caused by multiple interacting conditions and processes, as well as people's responses to these. The thesis will focus on differential vulnerability, and distinguish between collective and individual vulnerability, to emphasize how some are more vulnerable than others.

The second part of the analysis, chapter 6, will investigate how the solar Energy Centre in Ikisaya can contribute to sustainable adaptation, by reducing contextual vulnerability and enhancing coping and adaptive capacity. This chapter will focus especially on how the solar Energy Centre and its services might influence differential vulnerability. How the viability of the centre in turn might be influenced by the climatic and societal factors identified in chapter 5, is then discussed. The viability of the centre determine the sustainability of access to the services offered by the centre for people in the community, and is thus important for the long-term effects of the centre on vulnerability and adaptive capacity. This investigation will also use the socio-technical systems approach that emphasizes a holistic understanding of the dynamic relationship between technology and society.

Chapter 4: Methodological approach

This chapter will present and discuss the methodological approach employed to study contextual vulnerability and sustainable adaptation in Ikisaya, Kenya. The term ‘methodology’ refers to the entire process of research, or the overall research strategy employed to answer research questions, which includes a range of strategies and procedures, including methods of data collection and analysis (Alasuutari et al. 2008; Sumner & Tribe 2008). The term ‘methods’ refers in turn specifically to the means of undertaking research, the investigative techniques or tools used to gather and analyze data, such as interviews, surveys or observations, and is thus an integral part of the methodology (Sumner & Tribe 2008; Winchester & Rofe 2010). This chapter will thus describe the entire process of gathering and analyzing data for this thesis; what methods were used, how and why they were used, what ontological and epistemological approaches my methodology builds on and ethical considerations related to the research process. The chapter will also assess the quality of this research, and delineate strengths and potential limitations.

The research questions of this thesis aims at understanding how climatic and societal factors contribute to vulnerability in a community, how people respond to such challenges, how a solar Energy Centre might influence the vulnerability context and if local supply of solar energy can contribute to sustainable adaptation. I chose to employ a *qualitative* methodological approach, by some referred to as a qualitative research strategy, to study these social phenomenon, as I deem this to be the most appropriate. Qualitative research is usually referred to as the opposite of quantitative research, although the distinction between the two is sometimes fairly fluid (Bryman 2008b; Winchester & Rofe 2010). In general though, qualitative research aims at *understanding* social phenomena, social structures and human experiences, whereas quantitative research is concerned with *measuring* specific aspects of social phenomena, and aims at outlining general tendencies or test causal hypotheses (King et al. 1994; Winchester & Rofe 2010).

Qualitative and quantitative research thus generally aim at answering different kinds of research questions; employs different methods of data collection and analysis to answer the research questions; and rests on different ontologies and epistemologies. The qualitative approach generally use methods of collecting and analyzing data that focus on *words*, such as interviews, unstructured observation or discourse analysis, while the quantitative approach

generally gather *measurable* data through using methods such as questionnaires or structured observation, and analyze this data using numerical and statistical methods (Bryman 2008b; King et al. 1994). Using a qualitative research strategy was suitable to study issues related to vulnerability and sustainable adaptation in a rural village, as it allowed me to gain a broad understanding of the context and provided me with essential insight into intricate social processes.

4.1 Ontological and epistemological considerations

Social science research is closely related to philosophy of science; different visions of how to understand and study social reality (Bryman 2008b). *Ontological* considerations concern beliefs about how the world is, the nature of the ‘reality’ itself, whereas *epistemological* considerations concerns the questions of how we can study the world and what is regarded as acceptable knowledge (Bryman 2008b; Sumner & Tribe 2008; Winchester & Rofe 2010). As mentioned previously, the qualitative and quantitative methodological approaches generally rest on opposing ontological and epistemological positions.

Qualitative research is commonly associated with a constructionist ontological stance. *Constructionism* (sometimes used interchangeably with the term relativism) assumes that there exist multiple realities which are local and specific in nature. Interpretations of the social world is constructed by humans through social interaction, and is thus in constant revision (Bryman 2008b; Nilssen 2012; Sumner & Tribe 2008). A researcher might thus interpret and understand the social ‘reality’ differently than his or her informants (Nilssen 2012).

Quantitative research on the other hand generally belongs to an objectivist ontology. *Objectivism* asserts that the social world exists externally and independent of social actors, and can thus be uncovered by researchers (Bryman 2008a; Bryman 2008b). The ‘true’ nature of social phenomena can thus be discovered by researchers, according to objectivism, and their interpretation will coincide with how other social actors interpret the nature of the phenomena.

Qualitative and quantitative research also belongs to opposing epistemological approaches. Where qualitative research is associated with an interpretivist approach, quantitative research generally builds on a positivist stance. *Interpretivism* asserts that knowledge is a social and historical product of interpretations of the social world by both researchers and research

participants. Researchers are not detached from the social world; they have their own convictions and interpretations, just as their informants do. Interpretivism thus emphasizes the subjective in social research; the knowledge produced by researchers is not a neutral account of social phenomena, but knowledge is socially constructed and builds on subjective personal experiences (Bryman 2008b; Mabry 2008; Miles & Huberman 1994; Nilssen 2012).

It is somewhat difficult to give a general account of the positivist stance to epistemology, as the term is used in many different ways. However, in general, *positivism* promotes the application of natural science methods to the study of social phenomena. The objective reality can be measured, by gathering facts used to test hypotheses and make generalizations. Science must be conducted in a neutral and value free manner, to uncover the ‘truths’ of an objective reality. Positivism assumes that researchers are objective and independent of the social reality they study (Bryman 2008b; Mabry 2008; Sumner & Tribe 2008).

This presentation of ontological and epistemological approaches, and how qualitative and quantitative research relates to these, is of course a simplification and generalization. There are certainly a myriad of different ontological and epistemological positions, not only constructionism and objectivism, Interpretivism and positivism, but these are often referred to as the main opposing ‘camps’ of epistemological and ontological approaches (Bryman 2008b; Sumner & Tribe 2008). I thus find it sufficient for the purpose of this thesis to draw a distinction between these approaches and not go into further detail about philosophy of science.

This qualitative research also rests on a constructionist ontological approach. This means that I consider the social world to be socially constructed and is thus not independent of social entities. Furthermore, I think the most appropriate way of studying a socially constructed reality is through using an interpretivist epistemology that acknowledges the complexities of social interaction and recognizes that knowledge produced by a researcher is not neutral but builds on interpretations of the researcher himself or herself. The analysis of findings from my research is thus colored by my own interpretations of a socially constructed world. For example, this thesis investigates how factors such as social and cultural dynamics contribute to differential vulnerability in Ikisaya. The investigation builds on my informants’ accounts, which are their interpretations of the social reality, but this information is also partially influenced by my own interpretation of such dynamics. I thus acknowledge the potential

subjectivity of this research, and will further discuss how potential personal biases and convictions might have influenced this research in section 4.6.1.

4.2 Research design: the case study approach

This section will outline the research design of this thesis; the framework for collection and analysis of data (Bryman 2008b: 31; Sumner & Tribe 2008). There are many different research designs to follow in social sciences, but I chose to employ a qualitative case study research design for this thesis. *The case study approach* entails the detailed and intensive empirical examination of a specified unit, or case, in order to explore in-depth nuances and complexities of that particular case and possibly develop explanations that may be generalized to similar cases (Baxter 2010; Bryman 2008b; George & Bennett 2005; Mabry 2008). Yin (2009: 4) argues that “the case study method allows investigators to retain the holistic and meaningful characteristics of real-life events”, and Mabry (2008: 217) maintains that the case study “exhibits a profound respect for the complexity of social phenomena”. The case study approach thus emphasize the context of a particular case, and aim at gaining a holistic understanding of how various factors interact with one another in for example one particular setting (Baxter 2010).

The case study design can generally be divided in single-case studies and multiple-case studies (Miles & Huberman 1994; Yin 2009). This research is a single-case study as it only studies the one case of Ikisaya village to answer the research question. The ‘case’, or the unit of analysis, in this study is thus the village of Ikisaya in Kenya. The case study research design enables getting an in-depth understanding of contextual features and of social and environmental processes. I thus find it appropriate to use this research design to study contextual vulnerability, multiple stressors and the role of solar energy in sustainable adaptation to climate variability and change in a rural village in Kenya. Eriksen and Lind (2009: 819) also asserts that the case study research approach “provides an appropriate means of exploring adaptation, in particular, the way that local adjustments to change are shaped by interacting processes”.

There are many different variations of ‘cases’. I will argue that the case of Ikisaya village can be understood as a so-called ‘representative’ or ‘typical’ case, in that it exemplifies a broader category of similar cases (Bryman 2008b; Mabry 2008). Ikisaya village is to a certain degree representative of rural villages in developing countries that is not connected to the national

electricity grid, with high income poverty levels and reliance on climate-sensitive livelihoods such as rain-fed agriculture. However, social phenomena are to a great extent context specific, and the findings from this case study cannot readily be generalized to other similar cases, or to any populations beyond this case. Some aspects might be similar in other cases, but not all.

Further, case studies can be either cross-sectional or longitudinal. *Cross-sectional* refers to research conducted at one particular point in time, meaning that fieldwork is undertaken ‘once’, during a particular time. *Longitudinal* refers in turn to research based on multiple visits to the field, when a researcher returns to the case after a time period, and thus examines a case over a long time period (Baxter 2010). This case study is cross-sectional, as I was only in Ikisaya once. This study thus only examines and analyzes contextual conditions in Ikisaya and the Energy Centre in a particular time period. The purpose of this thesis is thus to explain features of Ikisaya as they were in October/November 2012, not how it might have been previously or changed after my visit to the area. I will thus refer to this as a ‘snapshot’ study.

4.3 Data collection methods

The choice of data collection methods is also related to the research questions; one needs to use appropriate methods to gather suitable data for answering the research questions. The qualitative methodological approach generally feature three data collection methods; observation, interviews and the review and analysis of case-related documents (Mabry 2008). This master thesis employs all these three methods of data collection, because the research questions demand a contextual understanding of the case. I thus find it necessary to gather and compare information from multiple sources to study vulnerability and sustainable adaptation in a local community.

Interviews were conducted and observations were made during a fieldwork in Ikisaya village from October 8th to November 5th, 2012. After fieldwork I have also reviewed case-related documents and data provided by the Solar Transitions research group, and I have gathered meteorological data from the Kenyan Meteorological Department. The following sections will describe how these data collection methods were used and why.

4.3.1 Observations

The purpose of doing observations during my fieldwork was to gain an understanding of what people *do*, and not only what they *say* they do. Yin (2009) argues that observations add new dimensions for understanding a context or phenomena. One of the strengths of observation as a method of collecting data is also that one can observe whether informants act differently than they say or intend to do (Walliman 2006). Observing how people behave can also provide a greater understanding of social and cultural dynamics than what is gained merely through interviews. For example, as I wanted to study how gender relations generate differential vulnerability, observing how women and men behaved towards each other, what activities women and men did respectively and hearing how people talked about the other gender outside of formal interviews was important for me to gain an understanding of such complex social and cultural dynamics. Observation thus certainly include *listening* as well as *seeing* (Kearns 2010). What people said outside of formal interview situations thus complement the information I got through interviews.

In general, one distinguishes between controlled and uncontrolled observation, and participant and non-participant observations. *Controlled* observation refers to research where the researcher decides explicitly how, when and what to observe beforehand, while *uncontrolled* observation is more flexible; a researcher might still be interested in observing certain aspects of a phenomenon, but also pays attention to other issues (Kearns 2010). The observations I did during fieldwork were uncontrolled. I was aware of some certain aspects I wanted to investigate, but I tried to keep my eyes and ears open to everything that was going on in Ikisaya when I did my fieldwork there, to gain a contextual understanding of the community.

Further, one usually makes a distinction between participant and non-participant observation. *Participant observation* is generally associated with ethnography (Armstrong 2008; Bryman 2008b), which involves research where the researcher spends a long time in a society he or she studies and has acquired fluency in the language used in the society being studied (Armstrong 2008). The researcher thus participates in the local community her or she studies. Bryman (2008b: 697) also define participant observation as “Research in which the researcher immerses him- or herself in a social setting for an extended period of time, observing behavior, listening to what is said in conversations both between others and with the fieldworker, and asking questions”. *Non-participant observation*, on the other hand, refers to situations where the researcher is a complete observer who only observes and does not

participate in the social setting. Such non-participant observation is sometimes also called *direct observation* (Bryman 2008b). However, some argue that it is difficult to make a strict distinction between what constitutes as participant or non-participant observation, as it is impossible for a person to be a complete non-participant in a social setting; “even those who believe that they are present but not participating in a research context often unwittingly alter the research setting” (Kearns 2010: 246).

This thesis is not based on ethnographic research, as I was only in the field for about four weeks. I will therefore not say I conducted participant observation during my fieldwork in the sense outlined above, as I did not ‘immerse myself in the social setting of Ikisaya for an extended period of time’. However, I think it is difficult to say that I was a complete non-participating observer as well. At times I participated in different activities in the village, at other times I was only observing the activities, but I was of course present in the community at all times. I will thus argue that the observations I did during my fieldwork were mostly non-participatory, in the sense that I did not participate directly in activities, and at times they were participatory, as I did participate in the activities.

Examples of ‘non-participant’ observations made during my fieldwork were observing activities such as a food aid distribution; measles vaccination of children; political rallies; farming activities; preparations for a funeral and so on. I visited many homes and I observed households using different sources of light in the evening, as well as using different methods of cooking. I also visited the Solar Energy Centre frequently, and observed how the services were being used by people in the community.

Examples of more participatory observations during my fieldwork include activities such as participating in household activities with the local family I lived with during my fieldwork. I assisted in preparing food, milking goats, buying foodstuffs at the market and so on. Some evenings I helped the children in the household do their homework. Living with a local family provided me with unique insights into life in the village, and allowed me to observe behavior in the private family realm. I got to observe how the family coped with the ongoing drought and how they prepared for the rainy season. I also gained a deeper understanding of the hardships they experience in their everyday lives, especially difficulties associated with scarcity of water, money and food, lack of electricity, health problems and the absence of transportation options. Further, I participated in a community meeting in the village, a *baraza*, where they discussed the construction of a new borehole. I had to present myself at the

meeting, and explain the purpose of my visit to the village. Being a participant at this meeting provided me with interesting insights into the dynamics of village decision-making procedures in the village, as well as water security issues.

I wrote down quite detailed notes about observations I did virtually every evening during my fieldwork. These *field notes* include summaries of informal conversations and reflections on events, activities and behavior. The field notes helped me uncover issues I wanted to investigate further and discuss in the formal interviews, and they enabled me to remember important observations and experiences after the fieldwork was completed. Field notes are thus used partly as empirical data, but they are used in this thesis with caution, acknowledging that as an outsider I might have ‘misunderstood’ certain actions, behaviors and dynamics in the community. The field notes are thus mostly used as *complementary* data in this research (Kearns 2010). Ethical considerations regarding using observation as a data collection method will be discussed in section 4.5 of this thesis.

4.3.2 Qualitative interviews

I did 64 qualitative interviews in total during my fieldwork; 50 semi-structured individual interviews, 13 key informant interviews and one focus group interview;

Qualitative interviews conducted during fieldwork		
Individual interviews	Key informant interviews	Focus group interview
50	13	1

Table 3: Types of qualitative interviews conducted during fieldwork.

The 50 individual interviews I did were *semi-structured*, whereby I used an interview guide (see Appendix 1) with a list of questions and topics I wanted to ask my informants (Bryman 2008b). The interviews were fairly flexible and the informants had great freedom in how to respond. The interview guide I used had about 60 questions, but I did not ask all informants the same questions, as some of the questions were not relevant to them all. I also added different questions when I found it necessary, I switched the order of the questions to try to make the interview flow like a natural conversation, and I asked follow-up questions if the respondent said something interesting. Sometimes I had to formulate my questions differently to make sure they understood the questions correctly, and at times I had to ask follow-up

questions to resolve inconsistencies in their responses. Doing semi-structured interviews allowed me to gain further insight into issues that I had not thought about beforehand, and it made it easier to customize the interview to the different respondents. Some of the questions had ‘yes’ or ‘no’ answers, but most of them were open-ended.

I also did 13 key informant interviews during my fieldwork. *Key informants* are people who have great knowledge about a certain issue or a distinctive viewpoint, and thus provide the researcher with perceptive information about a certain issue (Bryman 2008b; Thomas & Mohan 2007). The key informants I interviewed were chosen because of their knowledge about particular issues I wanted to explore further. I did not use the interview guide in appendix 2 during these interviews, but I developed a few open-ended questions and subjects I wanted to ask the key informants beforehand, and added relevant follow-up questions during the interview. These interviews were thus more like normal conversations.

I did one focus group interview with seven female participants as well. *Focus group* interviewing, also called discussion groups or group interviews, is a method of interviewing where a researcher interviews more than one, usually at least four, informants at the same time. The purpose of focus group interviews is to get together a group of people and have them discuss a topic in a fairly unstructured manner, in order to illuminate differences and commonalities in their views, opinions and experiences (Bryman 2008b; Cloke et al. 2004). Such interviews might bring forth issues that interviewees had not thought to bring up in individual interviews (Bryman 2008b). The focus group interview I conducted was also semi-structured, as I had a few pre-determined questions and topics I wanted them to discuss. I also added follow-up questions. This focus group interview was very interesting and useful, as I was able to see how the respondents discussed the topics with each other, and how they argued for their differing opinions and views. It was a bit difficult to ensure that all the participants spoke their minds during the interview, as some of them were more reserved and quiet than the others. However, I tried to ask follow-up questions specifically to those who did not speak their mind, to include them in the discussion as well.

I initially wanted to do a focus group interview with a group of men as well, but due to time constraints I was unable to organize two focus group interviews. I therefore prioritized doing a group interview with female participants, as I deemed this to be the most important. I had frequent discussions with men in the village, but local women were not involved in these discussions, both because of cultural customs and because of language barriers. Many of the

men in the village speak English, while very few women do. The discussions were in English. I therefore felt a greater need to organize a group interview with women to hear their opinions.

In general, I consciously tried to avoid asking leading or overly complex questions in all my interviews, to avoid influencing responses and avoid misunderstandings. I tried to ask straight-forward questions in a fairly simple language. I did one pilot-interview in the very beginning of my fieldwork to test the questions in my interview guide, and then had to alter some phrasings as some concepts or questions were misunderstood by the informant. Doing a pilot-interview was thus very helpful.

I used a digital tape-recorder during most of my interviews, but not during all interviews. I did not use a tape-recorder during the key informant interviews where I asked questions about more sensitive issues, as I wanted them to feel comfortable talking to me. I did not want them to worry that I would let other people listen to what they had told me. For the interviews where I did want to use a tape-recorder I asked them first if they were comfortable with me using the tape-recorder, and explained to them that I would not let anyone else listen to the interview. They all gave me permission to record the interviews, and they all seemed comfortable with the tape-recorder. I also wrote down some notes during the interviews, to make it easier for me to remember what they had told me and thus decide on which questions to ask and what follow-up questions to add. However, using a tape-recorder was very useful, as I was not able to write down everything they said. I also wanted to focus my attention on what the respondent said, and thus ask them the right questions. Using a tape recorder permits a repeated examination of the interviews and thus allows for a more thorough examination of interview data (Bryman 2008b). Recording the interviews also made it possible to present direct quotes from my informants in the analysis part of this thesis.

Furthermore, I used a translator during most of my interviews, but some of the respondents had gone to secondary school and spoke English quite well. For those interviews I thus did not use a translator. In order to be sensitive to gender dynamics, I used a male translator when I interviewed men and a female translator when I interviewed women, except for once, when I had to use a male translator to interview a female informant for logistical reasons.

Most of the interviews I did were conducted outside of the respondents' homes, or while sitting under the shade of trees near the market area in Ikisaya. Some of the interviews were done while sitting in small restaurants at the market area while the respondent was having a

cup of tea. During most of the interviews I asked the respondent to sit with only my translator and myself a small distance away from other people, to make sure that they would speak freely and not be concerned about other people listening to their responses. However, sometimes the respondents seemed to feel more comfortable having a few of their friends sitting closer to them, and I thus allowed them to be present during the interview. I do not think that influenced the sincerity of their responses.

4.3.2.1 Sampling procedure

When choosing respondents for interviews, you need to define the *population* you want to study first, and then draw a sample from this (Thomas & Mohan 2007). I defined the population of this study to be people living within the Ikisaya sub-location (also called Syou sub-location) and above 18 years-of-age. I then decided on the *sample size*. I decided I wanted to interview 50 individuals using the semi-structured interview guide; interview an unstipulated number of key informants and organize at least one focus group interview with minimum five participants. I did not interview two persons from the same household, such as a husband and wife, for the semi-structured individual interviews. This was because in addition to asking questions pertaining to the individual, I also asked them some questions about their households, and asking two people from the same household the same question would make it impossible to compare households in addition to individuals. Hence, my 50 individual informants represent 50 households; about 13 percent of the total number of households in Ikisaya (377 households).

I then decided on the *sampling frame* used to choose informants to interview. I used a non-probability sampling frame, also called *strategic sampling*, to sample the 50 individual informants. Strategic sampling involves choosing respondents that have certain characteristics or qualifications that are relevant to the research question and theoretical framework (Thagaard 2009). As this is a qualitative and not a quantitative study, I did not strive to draw a representative sample from the population using probability sampling. My respondents are therefore not necessarily representative of the wider population of Ikisaya.

There are three main types of such strategic, non-probabilistic, sampling; convenience sampling, snowball sampling and quota sampling (Bryman 2008b). I did a combination of quota sampling and convenience sampling during this research. *Quota sampling* refers to choosing informants from a population with the aim of ensuring relative proportions of people in various categories (Bryman 2008b; Thagaard 2009). I used quota sampling to make sure I

had an equal distribution of female and male respondents in my sample. I thus set a quota of 25 female and 25 male respondents, because I found it to be important to get opinions from both men and women, as they often have opposing views and experiences. Men were generally not present during interviews with women, and vice versa. This was important, as I did not want the presence of the opposite gender to influence how my informants responded during the interview.

Further, I wanted the respondents to be of different ages, different clans, having different occupations, different marital statuses, and different educational levels, as these vary widely within the community and may influence vulnerability (Eriksen & Lind 2009). I also wanted to interview some people who used the services at the Energy Centre, and some that did not use them. However, I did not want to set a quota for each of these characteristics, as it would be very difficult to find the correct number of respondents having all these different characteristics. I therefore then used convenience sampling instead of quota sampling. *Convenience sampling* refers to a process of selecting respondents who encompass different characteristics relevant to the research questions, based on their availability to the researcher (Bryman 2008b; Thagaard 2009).

In the beginning, I just walked around the market area with my translator and asked people if I could interview them. I thus picked 'random' people and asked them for an interview. As I was there during the dry season, most of the people in the village went to the market area to fetch water and buy food almost every day. There were therefore always a lot of people in that area. Sometimes I interviewed them right then and there; other times I made an appointment to come to their home at a later point in time. After a while, when I felt I needed more people from certain categories, I asked my translators to identify people with certain characteristics for me. For example, I said I would like to interview some casual laborers, businessmen, single parents and so on. My translators thus helped me select some of my informants, based on my instructions, and might have made the sample somewhat biased.

One of the reasons why I chose to find most of my informants at the market area in Ikisaya was because of the scattered settlement pattern, great distances and high transportation costs. In order to improve the geographical distribution of informants, I bought a motorbike. Travel was nevertheless constrained by the need for fuel and a driver (it was not advisable to travel alone), and even riding a motorbike to many places of the village is quite difficult because of the absence of roads and due to the difficult terrain. Walking long distances to reach some

people was very time-consuming; hence, it was more efficient to find people at the market area, since people from all areas of the village came there. Nevertheless, the constraints to my travelling to the distant parts of the village influenced the geographical distribution of respondents in this study, as I will show in the next section.

The key informants I interviewed were chosen on the basis of their knowledge about particular issues I wanted to investigate more in-depth. These respondents were thus also picked strategically from the population. To protect anonymity, I will not describe who these key informants were, but they were chosen because of their particular knowledge about education; health; politics; water; illegal hunting; brewing of Kaluvu¹¹; and Ikisaya Energy Centre. I identified most of these key informants myself, but some were identified by my translators. In those cases, I asked my translators “who knows a lot about this issue?”, and they identified a certain person for me whom I then asked for an interview.

The seven female participants in the focus group interview were found sitting together at the market area in Ikisaya, waiting for relief food distribution. I asked them through my translator if they would like to join a focus group interview after they had received the food. They seemed excited to be asked, and agreed instantly. The interview was held in one of the ‘restaurants’ at the market area.

4.3.2.2 Key characteristics of informants

This section will present some key characteristics of the 50 informants in this study (key informants and focus group participants are excluded from this presentation, as I did not systematically gather the same amount of background information about these). As mentioned in the previous section, I wanted my informants to form a heterogeneous group, as I found it useful to have informants with a variety of experiences and attitudes. For example, I wanted to investigate if people in the area feel the climate has changed the last decades. I therefore wanted to interview some old people who could compare how the climate is today with how the climate was when they were young. My oldest informant was 84 years, while the youngest was 25. Age distribution of my informants is presented in figure 3;

¹¹ A local ‘beer’ brewed by some in Ikisaya. This is discussed in detail in section 5.2.2.1 of this thesis.

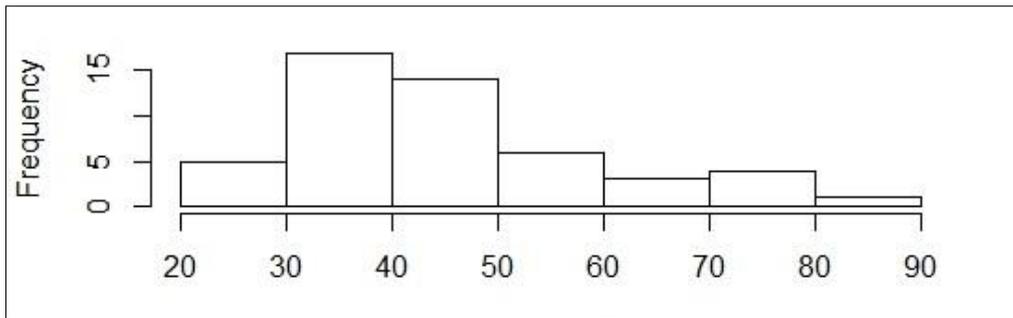


Figure 3: Age distribution of respondents in this study ($n=50$).

Further, I wanted to interview people belonging to a variety of clans, because clans are fairly important informal social networks in the community. There are approximately 11 clans in the community. Some clans are more populous than others, and regarded as more powerful than the smaller clans, and there are some tensions between the various clans. I therefore wanted to make sure my sample included respondents from as many clans as possible, both smaller and bigger clans. My sample includes respondents from 10 clans. However, not all clans are equally represented in my sample. As explained in the previous section, I tried to balance different kinds of characteristics, and it was different to set a quota on clans in my sample. However, my sample does reflect to some degree the relative size of the different clans within the community. I was told by my informants that the two ‘biggest’, the most populous, clans in the community are Mwathi and Kanyaa, while Asauni and Ketondo are other rather big clans.

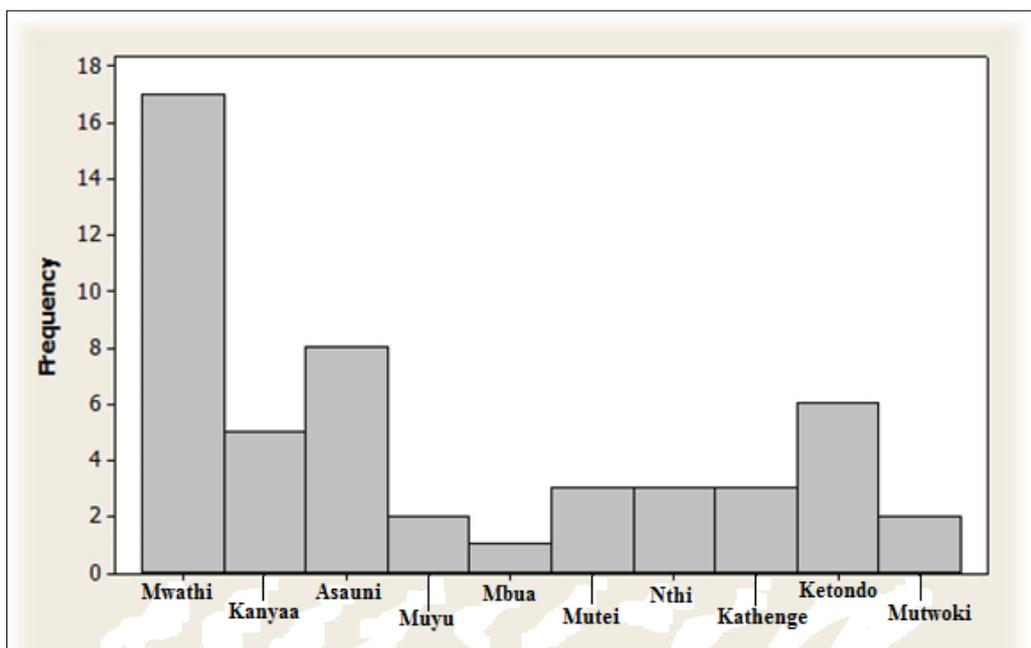


Figure 4: Clan membership of respondents in this study ($n=50$).

When it comes to the geographical distribution of my informants' residency within the village, most of my informants (26 of 50) come from Ngovovoni; the area surrounding the market area, where the Energy Centre is located (see location of other sub-villages on map 4, page xiv).

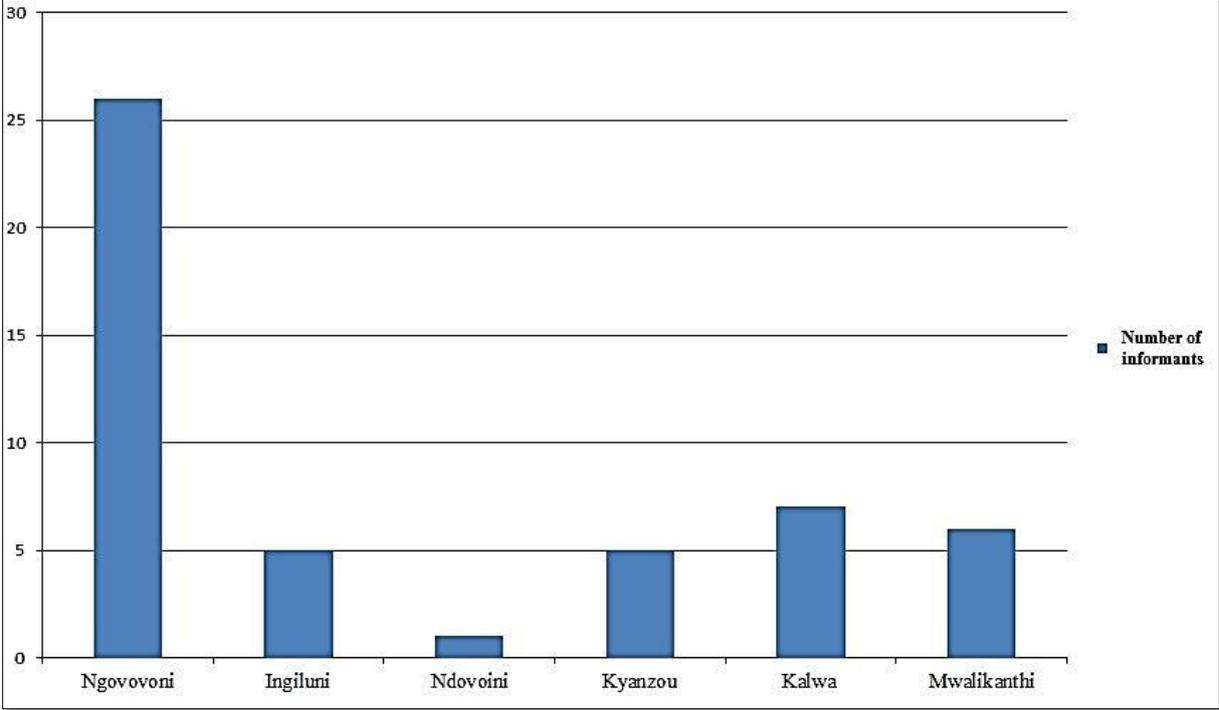


Figure 5: Residency of informants in the sub-villages of Ikisaya (n=50).

4.3.3 Case-related documents

The third of the three methods I used for collecting data for this thesis was reviewing and analyzing case-related documents. I was provided with various internal documents written by the Solar Transitions research group regarding Ikisaya and the Energy Centre, such as reports from field visits written by Kirsten Ulsrud (leader of the Solar Transitions research project), minutes from various meetings, financial reports from the Energy Centre, results from a survey conducted in Ikisaya and so forth. These are used as empirical data in this thesis, and provided me with a greater insight into the process of developing and operating the Ikisaya Energy Centre.

I also received precipitation statistics from the Kenyan Meteorological Department. I contacted the director at the Meteorological Department from Norway, and he sent me the data electronically. I had to pay for this data. I received records of total monthly rainfall between 1960 and 2012 from Makindu Meteorological Station. I was told that this was the

nearest meteorological station to Kitui with records that go so far back. Makindu is however located about 100 km southeast of Ikisaya (see location on Map 2 on page xiii), and do not necessarily represent levels of precipitation in Ikisaya accurately. Still, Makindu is also a dryland area and is sufficiently close to Ikisaya that it is likely that the records represent general trends and annual variations in precipitation more or less correctly. I analyzed the records using Excel.

4.4 Data analysis and interpretation

I transcribed all the interviews I did verbatim on a computer, by listening to what I had recorded and looking at the notes I made during the interview. This was a very time-consuming process, as I had many hours of interviews to transcribe, and transcribed them all word-by-word. This was nevertheless very useful, as I got to go through the interviews thoroughly, and did not miss any information. However, qualitative research produces large bulks of verbatim data, and it might be difficult to get an overview of general tendencies. It is therefore necessary to structure and synthesize the empirical data, in order to interpret how they relate to the research questions. This process of systematically arranging transcribed interviews, field notes and other documents to find patterns is referred to as *data analysis* (Bogdan & Biklen 2007).

I used a so-called *issue-centered analysis* on my data. An issue-centered analysis involves comparing information about different issues, or topics, in all interviews and field notes (Thagaard 2009). This involves choosing different issues, or categories, that are relevant to your research question, and comparing the information different respondents have provided about these different issues. The purpose of this is to gain an overview of the complexity of the data and find general tendencies (Thagaard 2009). There are different methods to use when doing an issue-centered analysis, such as developing tables or matrices, or doing so-called color coding. I did a combination of color coding and developing matrices to conduct an issue-centered analysis. *Color coding* involves assigning different colors to statements that relate to certain pre-defined categories, or codes (Bryman 2008b). I used *color coding* on the transcribed interviews to highlight statements relevant to certain topics, such as climate variability, coping strategies, gender relations, use of solar energy and so on. The advantage of doing color coding is that you get a clear visual overview of the statements that are relevant to your research questions.

I then compiled the ‘color coded’ statements in matrices. I did not do this on all topics discussed in interviews, only those where I found it difficult to get a clear overview of the complexity in responses and thus needed to compile them visually. However, when isolating different statements and inserting them into tables, you take the statements out of its context and risk losing important contextual relevance. It is therefore important to retain a holistic overview of the data when you break it down into comparable statements (Thagaard 2009). I have read through the transcribed interviews in their entirety countless times during the analysis and interpretation process, and I am certain I have a thorough overview of the empirical data. I have also analyzed some of the empirical data, such as background information about informants, by using the statistical computer software’s Excel and RStudio.

4.5 Ethical reflections

The conduct of social research necessarily has an influence on society and the people in it. By asking questions or participating in an activity, we alter people’s day-to-day lives. And communicating the results of research can potentially change social situations (Dowling 2010: 26-27).

Social science research necessarily entails various important ethical considerations and dilemmas. The mere presence of a researcher in a social setting might, in often unforeseen manners, alter the social situation, and in the ‘worst case scenario’; hurt people in that society. Ethical awareness throughout the entire research process is therefore essential. I will in this section reflect upon how ethical principles were endorsed during the research for this thesis, and discuss ethical dilemmas faced during the fieldwork.

Before travelling to Kenya to do fieldwork, I reported my project to the Norwegian Social Science Data Services (NSD) to get permission to conduct research for this thesis. My application was approved, on the premises that I follow ethical guidelines when conducting my research. The most common ethical guidelines, or principles, cited in research methods literature include; the researcher must ‘do no harm’ to participants, acquire informed consent from informants, avoid invasion of privacy, avoid deception of research participants, and treat information provided by informants confidentially (Bryman 2008b; Dowling 2010; Nilssen 2012; Thagaard 2009). These five principles are interlinked in various ways, and they all aim at ensuring that the social research process protects the integrity of respondents and does not cause harm to anyone involved in the research.

The first principle, *'Do no harm'*, maintains that the researcher should avoid inflicting physical or mental harm on research participants directly or indirectly (Miles & Huberman 1994; Nilssen 2012). The researcher should thus not expose research participants to negative consequences. For example, a researcher must not disclose sensitive information provided by an informant to other members of the community if there is a chance that might cause harm to the informant. I have been conscious during this research to avoid harming anyone. My research has thus not subjected anyone to physical or mental harm, at least not that I am aware of. I tried to make the respondents feel as comfortable as possible during interviews, and I don't think they felt intimidated by me, as I was just a young, female student. Most of the questions I asked were fairly unproblematic and were not about sensitive issues. However, I asked some of my respondent's questions about more sensitive issues, such as gender relations and 'illegal' activities. I only asked these questions to people that seemed comfortable to talk about these issues, and they happily answered these questions as well. Some of them even seemed pleased to be able to talk about issues they found problematic. A few of them told me after the interview that they had enjoyed discussing issues that they found to be very important, and that they were glad that I showed an interest in understanding problems they were facing. Protecting the identity of my informants who told me about 'illegal' activities is thus very important in this thesis, as it is important not to expose people who might in the worst case be arrested. This principle thus coincides with the principle of confidentiality.

The second ethical principle, *informed consent* implies that every informant in a study should be given sufficient and accurate information by the researcher to make an informed decision about whether or not they want to participate in the study (Bryman 2008b; Dowling 2010). When I approached potential respondents, I explained who I was, why I was in Ikisaya, what I was studying, and how the information they gave me would be used. I informed them that participation was strictly voluntary; that they could refuse to answer any of the questions and that they could withdraw from the interview at any point of time. I also added that they could withdraw any information they had provided me with, even after the interview was finished, if they later were to regret giving me certain information. I thus gained informed consent from the informants in this study.

The third ethical principle involves respecting the *privacy* of informants and other villagers in the community where the research takes place (Bryman 2008b; Dowling 2010). I was very conscious about making sure I was not invading the privacy of anyone in the village, and

asked my respondents when and where they would prefer to be interviewed by me, and explained that they did not have to share any information with me that they found to be too personal or answer questions they felt were uncomfortable discussing. This principle also overlaps with the ethical principle of confidentiality; it is important that private details about informants are not disclosed publicly (Dowling 2010).

My research did not involve any *deception* either. “Deception occurs when researchers represent their work as something other than what it is” (Bryman 2008b: 124). This again relate to the issue of informed consent, as the participants in research must be given all necessary information about the research and the researcher. I did not withhold or misrepresent any information about myself or my research to anyone I came into contact with during my fieldwork.

Doing observations during fieldwork might possibly challenge the ethical principle of avoiding deception. Observations can be either covert or overt. *Covert observation* means that the researcher does not reveal or disclose his or her identity as a researcher in the community being studied, and thus violates the principle of avoiding deception. Covert observations also violate the ethical principle of informed consent, as participants are not given information about what they are participating in (Bryman 2008b). *Overt observation* is the opposite of covert; the researcher informs the study objects of his or her identity as a researcher. However, a researcher might come into contact with people during field work that does not know that he or she is a researcher, and making a clear distinction between the two might thus be challenging (Bryman 2008b). I strived to make sure my identity as a student doing research in the village was known by all the people that I came into contact with during my fieldwork. Being a white foreigner in this small rural village meant that I attracted a lot of attention from the local villagers, and I think they were all aware that I was a student doing research there. The observations I did were accordingly overt and did not involve any deception of my agenda for being there, and did not violate the principle of informed consent.

The ethical principle of *confidentiality* involves making sure the information the researcher is provided with is not shared with anyone else, and usually requires the researcher to make respondents anonymous when publishing results from the research (Thagaard 2009). I have made all respondents anonymous in the thesis, to avoid revealing the information I got from the different respondents. As this thesis will discuss some illegal activities, anonymization is especially important. I have therefore chosen to not give the informants fake names or

numbers, as I do not want readers to be able to compile quotes and possibly recognize my informants. I treated all the information I got access to as strictly confidential, and I informed my informants about this before conducting interviews. I have thus not shown interview transcripts or field notes to anyone.

However, ensuring confidentiality might be challenging when using local translators. If the translator is a member of the community the researcher studies, that translator might know the people being interviewed, and there is the possibility that they might share information they come across during interviews with other members of the community. It is therefore very important to instruct the translator carefully about these issues to avoid that they breach the confidentiality principle. I instructed both of my translators about the importance of confidentiality before starting the research, but I still experienced that one of my translators breached this principle once. I overheard the translator discussing an issue that had come up during an interview with a different villager. I then interrupted their conversation, and repeated to the translator that sharing information from interviews was unacceptable. As far as I am aware, it did not happen again. I thus tried to uphold the principle of confidentiality during this research, but I do recognize that using local translators might have challenged this principle. (Section 4.6.2 will discuss how using translators might influence the quality of research.)

Another ethical dilemma that might arise during fieldwork concerns the issue of *payment* or compensation to interview respondents. Decisions on whether or not to use monetary incentives to entice respondents to participate in research requires a “consideration of how monetary inducements will affect the quality of data as well as the equitable distribution of the benefits and burdens of research participation” (Fisher & Anushko 2008: 104). I decided not to use monetary incentives during my research, and thus never paid any of my respondents for letting me interview them. I did this for several reasons. First of all, I did not want to ‘lure’ or tempt people who would otherwise not participate in my research into participating. Secondly, payment for research participation might influence the response the respondents give during interviews. If they are being paid for the interview, they might alter their responses towards answering what they think you want them to answer (Fisher & Anushko 2008). Finally, and I think most importantly, as I would not interview everyone in the community, paying some villagers to be interviewed would be unfair to those who were not “chosen” by me to be interviewed.

The issue of payment was however somewhat problematic at times. When I approached potential respondents to my study, I told them that I would not be able to give them anything for the interview. Most of them said that was not a problem, but some said that they did not want to do an interview unless they were paid for it. I thus lost some potential respondents because of this. Some of my respondents asked me to give them different things after the interview was finished, even though I had already explained to them that I could not give them anything. I then had to repeat that I could not give them anything, and apologized deeply.

Ethical problems can also occur when choosing translators, drivers and accommodation. I did not want to influence social dynamics in the community negatively during my fieldwork, and I was aware that the selection of translators, drivers, and where to stay could have social implications. For example, I knew that the informal social network of clans was quite permeated in the community, and affiliating myself with members of one clan could perhaps cause dissatisfaction among other clans. I therefore wanted to employ people from different clans as translators and drivers. This was somewhat challenging, due to practical reasons. I wanted to use a translator that did not work at the Energy Centre, because I was worried that might have implications for the responses I got during interviews. There were therefore very few people in the community who spoke English well enough to act as a translator and who had time to work for me. I therefore ended up using a translator who was a relative of to the family I was staying with in the village.

However, another master student from Norway was in the village doing fieldwork at the same time as me, and she was also living with and using a translator from this same family. As explained earlier, at the time of my fieldwork many people in the village lacked basic necessities such as food and water. When two white girls came to the village to do research, people saw this as an opportunity to get some kind of benefits from our visit. However, to some of the villagers, our visit appeared to only benefit members from one family; one clan. That caused dissatisfaction in the village, and our visit seemed to ‘stir’ up tensions between clans and families in the village. To ease these tensions, I therefore decided to look for a new translator. Fortunately, I met a woman at the market in Ikisaya who spoke English very well and was available to work for me. She did not belong to the same clan. I then decided to use her during my interviews with women, which was advantageous for several reasons. This worked out very well. Using a translator from a different clan fortunately seemed to ease the tensions that had evolved in the village.

4.6 Assessing the quality of the data

There are many different criteria used to assess the quality of social research. The two most common criteria for evaluating quantitative research are reliability and validity. *Reliability* concerns the critical examination of the research process in itself, to maintain that the research is reliable and trustworthy. Another researcher should get the same findings if he or she were to replicate the research process. *Validity*, on the other hand, concerns the accuracy of the analysis and interpretations of data in a research project. The interpretations made by a researcher should be justified with reference to the data, such that the validity of the findings can be examined by other researchers (Thagaard 2009). The criteria of reliability and validity are not as readily applicable to qualitative research as it is for quantitative research, and various alternative criteria have thus been promoted by different scholars. One such alternative measure of the quality of qualitative research is the concept of *trustworthiness*. This concept concerns the issue of whether or not the results of a research project can be trusted, and is comprised of four criteria; credibility, dependability, transferability and confirmability (Bryman 2008b; Sumner & Tribe 2008). I will use these four criteria to evaluate the trustworthiness of my research project.

The criteria of *credibility* concerns how believable your findings are (Sumner & Tribe 2008). Bryman (2008b) argues that there are two main ways of increasing the credibility of a research project; *respondent validation*, which entails allowing informants to assess research findings before they are published, to make sure the researcher has understood the information provided by the informant correctly; and *triangulation*, which involves using more than one method of data collection or one source of data in the research. This study employs a ‘multi-method’ research approach whereby qualitative interviews, observations, and case-related documents are combined to gain a holistic understanding of the case and to answer the research questions. Using triangulation thus increases the credibility of my findings. I have however not acquired respondent validation, because it is somewhat difficult to send the draft of my thesis to all of my informants in Ikisaya to have them confirm that my analysis is correct. Further, most of my respondents do not speak English and many of them are illiterate, so I would thus need someone to translate the text into Kikamba. I think this is unnecessary for a master thesis.

The criteria of *dependability* concerns “the extent to which a set of findings are likely to be relevant to a different time than the one in which it was conducted” (Sumner & Tribe 2008:

114). In theory, the researcher should thus explain thoroughly how the research has been carried out, and what choices has been made during the research process, such that other researchers can replicate the research process and get the same findings. This criterion thus also entails transparency of the research process. I have explained in great detail the research process for this thesis in this methodology chapter to ensure transparency of my research. However, social settings are dynamic and continuously evolve. My findings are specific to the time when I did my fieldwork, and will not necessarily be similar later.

Transferability refers to the extent to which findings from one setting are relevant to other settings, and can be generalized across social settings (Bryman 2008b; Sumner & Tribe 2008). Transferability of qualitative research might be problematic, especially when it comes to case studies, as it might be difficult to determine whether a “study’s findings are generalizable beyond the immediate case study” (Yin 2009: 43). Although the findings from this case study cannot readily be transferred, or generalized, to other cases, the findings from this case study can be compared to findings from other case studies on the same topic. By comparing different case studies it might be possible to find common patterns and tendencies, as well as differences, between the cases. This case study might thus provide with useful insight into the relationship between decentralized solar energy and sustainable adaptation in a rural village in a developing country, although the findings might not necessarily apply to other contexts and settings.

The forth criteria of trustworthiness, *confirmability*, requires that the researcher has not allowed personal values or theoretical inclinations to influence the conduct of the research or findings excessively (Bryman 2008b; Sumner & Tribe 2008). Qualitative research is often criticized for being overly influenced by the researcher’s personal biases, opinions, points of view, experiences and agendas (Bryman 2008b), and it is thus important for the researcher to be aware of these issues to avoid influencing findings. I have strived to avoid letting personal opinions, worldviews and biases influence the research process, by being aware of these. For example, coming from a western country (Norway) where gender equality is greatly accentuated, might have influenced how I interpreted gender relations in Ikisaya. Further, I think poverty and lack of opportunities inhibits people from attaining what they deem to be fulfilling. Personal opinions shaped by growing up in a western country thus influence the ‘lens’ in which I see the world through. To reduce the risk of allowing personal beliefs and opinions overtly influence my research and findings, I kept an open mind, I avoided asking leading questions during interviews, and I did not share my personal opinions with anybody in

the village to avoid influencing their responses. Further, by recording interviews I was able to correct biases in what I noticed during interviews at a later stage. During interviews one might 'hear what one wants to hear', but listening to the interviews again made sure I heard exactly what my informants said. The quotes from my informants that I recount in this thesis are thus accurate, and not influenced in any way by my own, potentially flawed, interpretations. I will therefore argue that my findings are confirmable.

4.6.1 Using translators

Using a translator during interviews might pose a threat to the trustworthiness of social research in various ways. There is always a possibility that the translator influences the responses one gets from an interviewee intentionally or unintentionally. The translator might not translate sentences correctly, the translator might try to impose his or her own views on the interviewee or persuade the interviewee to answer something else than he or she would have answered otherwise. Using a translator might also involve power relations, and might thus influence how much an interviewee is willing to share of personal opinions and attitudes (Kapborg & Berterö 2002). Threats to the quality of information obtained through social research "may arise if the interpreter: is not trained properly, does not have a full understanding of the particular research project, or has biased ideas" (Kapborg & Berterö 2002: 54).

It is thus important to be aware of these issues when using a translator, in order to avoid that the translator influences the interview situation and the information acquired. First and foremost, the translator needs to be given clear instructions of how to translate the interviews before starting the interview process. I explained to my translators that I wanted them to translate the interviews as verbatim as possible, translating every sentence directly to English. I did not want them to summarize or interpret their answer in their own way, as I did not want to lose any information. I also went through the interview guide with the translators beforehand, and explained what I meant with every question, what I wanted to investigate and how I wanted them to behave during the interview. I told them that I was directing the interviews, I would ask every question myself, I would add follow-up questions, and I would determine when to finish the interview.

In order to 'check' if the translation seemed correct, I sometimes tried to ask follow-up questions or ask the question differently, to check the consistency of the answer. Further, I

understand Kiswahili fairly well, a language that is quite similar to the local language Kikamba, and I could therefore to some extent check if the translation was more or less accurate. I also observed the body language of the respondents to make sure it was consistent with their answers. Listening to the recorded interviews further enabled me to check the accuracy of translation. I therefore think the translators translated more or less accurately at all times.

Although I think the translations of statements were accurate, the translators might have influenced what the informants told me during interviews to some extent. The male translator I used was highly educated and came from a quite powerful family in the community. There was hence an unavoidable power imbalance between the translator and some of the informants, and some of the respondents may have felt somewhat intimidated by the translator, influencing their responses about some issues. The female translator was also highly educated, but she was of a smaller clan, and I think there were fewer such power imbalances between her and the female respondents. In spite of these challenges associated with using local translators, I still think it was better to use local people as translators than bringing ‘outsiders’ in to translate for me.

There were many advantages of using local translators in this research, advantages I think outweigh the potential influence they might have had on the responses I got during interviews. They knew the local setting in-depth and could thus give me important contextual information. If my informants did not understand certain questions, the translators explained the questions to them in an understandable way. They could introduce me to potential informants in a ‘culturally sensitive’ manner, which made people feel comfortable talking to me. I would not have been able to gain a lot of the information I got during my fieldwork if it had not been for my translators. People would for example not have discussed illegal activities with me so openly if I had not used these local translators whom people trusted. I therefore do not think using local translators reduce the trustworthiness of this research.

4.7 Summary

This chapter has outlined the methodological approach and research process of this thesis, discussed methodological choices I have made along the way, and reflected upon ethical dilemmas I experienced during my fieldwork. The study has employed a qualitative case study approach to examine the contextual vulnerability to climate variability and change, and the relationship between solar energy and sustainable adaptation to climate change, in Ikisaya village in Kenya. The methods for collecting data for this thesis have been qualitative interviews, observations made during a fieldwork in the village and review of case-related documents. This chapter has also discussing issues related to the credibility, dependability, transferability and confirmability of my study, and I argue that in spite of various limitations, the findings of this study are trustworthy.

Chapter 5: The vulnerability context in Ikisaya

This chapter will address the first sub-question of this thesis;

- i) *How do climatic and societal factors, and people's responses to these, contribute to contextual vulnerability in Ikisaya?*

As discussed in chapter 3, the theoretical framework, 'contextual vulnerability' is understood as a present state of inability to cope with external pressures or changes, generated by multiple factors and stressors (O'Brien et al. 2004). The vulnerability context is made up of a range of political, institutional, economic, and social conditions and processes (Eriksen & Lind 2009). Hence, contextual conditions influence how vulnerable individuals or communities are to climate variability and change. These contextual conditions or factors can be referred to as the underlying 'drivers of vulnerability' (IPCC 2012). However, individuals, households or groups are not equally vulnerable; some are more vulnerable than others. Vulnerability is thus differential (Eriksen et al. 2008). The ability to respond to the drivers of vulnerability is an integral part of differential vulnerability. Some individuals or households have a higher capacity to cope with current challenges and adapt to future changes than others, and are therefore less vulnerable. The drivers of vulnerability, and people's responses to these, are inextricably linked.

This chapter will investigate the character of contextual vulnerability in Ikisaya by examining various climatic and societal factors, the 'drivers of vulnerability', and exploring how people respond to these. Climatic and societal factors are however not experienced in an isolated manner; they coincide and reinforce each other in various complex ways. The main climatic factors that contribute to vulnerability in Ikisaya are high rainfall variability, frequent droughts and occasional floods. These factors will be discussed in the first part of this chapter. The next part of the chapter will outline the main societal factors that contribute to vulnerability, focusing on economic and political conditions, as well as social and cultural dynamics. The main strategies people employ to cope with current challenges and adapt to changes in the longer term, will then be discussed. Based on the findings from these two sections, the chapter will then discuss how climatic and societal factors, and people's responses to these, contribute to contextual vulnerability in general, and differential vulnerability in particular, in Ikisaya.

5.1 Drivers of vulnerability

In order to identify factors that contribute to vulnerability in Ikisaya, I asked my informants what they considered to be the greatest threats to their well-being; the greatest challenges they are facing. Water scarcity was considered by the majority of my informants to be the greatest challenge they were facing. As one of my informants put it so eloquently; “*Water is life. Without water you cannot live a good life.*” Other challenges identified by my informants include climatic variability and change, poverty, unemployment, political marginalization, conflicts and tensions with nomadic pastoralists. The following sections will outline and discuss these main climatic and societal factors that shape the vulnerability context in Ikisaya.

5.1.1 Climatic factors

Ikisaya is a rural area located in the semi-arid Kenyan drylands, defined as areas receiving annual rainfall below 1,000 millimeters (mm). The area is characterized by a hot, dry climate (Gachathi & Eriksen 2011: 60). There are no meteorological stations in Ikisaya, but Kitui Meteorological Station, located about 45 km southeast of Ikisaya (see map 2, p. xiii), recorded a mean of 668 mm of annual rainfall between 1961 and 1990 (Eriksen & Lind 2009). Makindu Meteorological station, located about 100 km southeast of Ikisaya (map 2, p. xiii), recorded a mean of 593 mm of annual rainfall between 1960 and 2012 (Kenya Meteorological Department). Although Kitui is located closer to Ikisaya, Kitui generally receives more rainfall than Ikisaya. Records from Makindu Meteorological station are therefore likely to be more representative of climatic conditions in Ikisaya.

Ikisaya has a bimodal rainfall pattern, caused by the biannual migration of the Intertropical Convergence Zone (ITCZ) across the equatorial Eastern Africa region (Wolff et al. 2011). In other parts of Kenya, the rain that falls between March and May is referred to as the ‘long’ rainy season, while the rain that falls between October and December is referred to as the ‘short’ rainy season. However, in Ikisaya they refer to them oppositely; they refer to the rain falling between March and May as ‘the short rains’, and the other as ‘the long rains’ (Focus group interview). The ‘long’ rainy season often extends into January, and brings more rain than the short rainy season in this area, as evident in the figure below. The long rainy season is therefore generally considered to be the most important in the area (Eriksen 2005; Focus group interview).

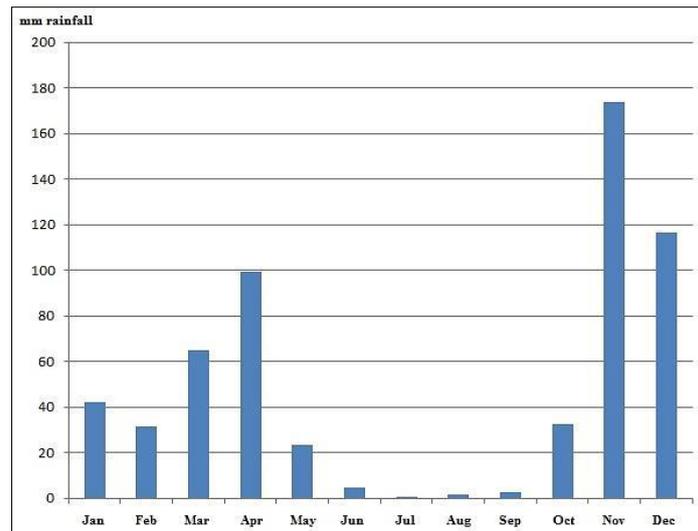


Figure 6: Mean monthly rainfall, 1960-2012, Makindu Meteorological Station (Source: Kenya Meteorological Department).

5.1.1.1 Climatic variability and change

The rainfall in the semi-arid Ikisaya area is not only generally low; it is also highly variable and unreliable. The rainy seasons frequently fail, leading to recurrent droughts, and high intensity rainfall events cause occasional flooding (Eriksen 2005; Gachathi & Eriksen 2011; Owuor et al. 2005). Inter-annual rainfall variations in eastern Africa are tightly linked to the El Niño Southern Oscillation (ENSO). Strong El Niño events usually bring heavy rainfall, while strong La Niña events usually cause drier conditions (Goddard & Graham 1999; Wolff et al. 2011). For example, an El Niño event in 1997 caused particularly heavy rainfall and floods in many parts of eastern Africa, while the severe droughts in East Africa, such as the one experienced in 2011, have been attributed to strong La Niña events (Coghlan 2011; Eriksen 2005; Hussein 2011). High rainfall variability is clearly evident in total annual precipitation recorded between 1960 and 2012 at Makindu Meteorological station (Fig.7). Annual amounts of rainfall varied between 226 mm and 1,246 mm from 1960 to 2012. The standard deviation from the mean in the period 1960-2012 was 718 mm, representing very large inter-annual variation in rainfall.

;

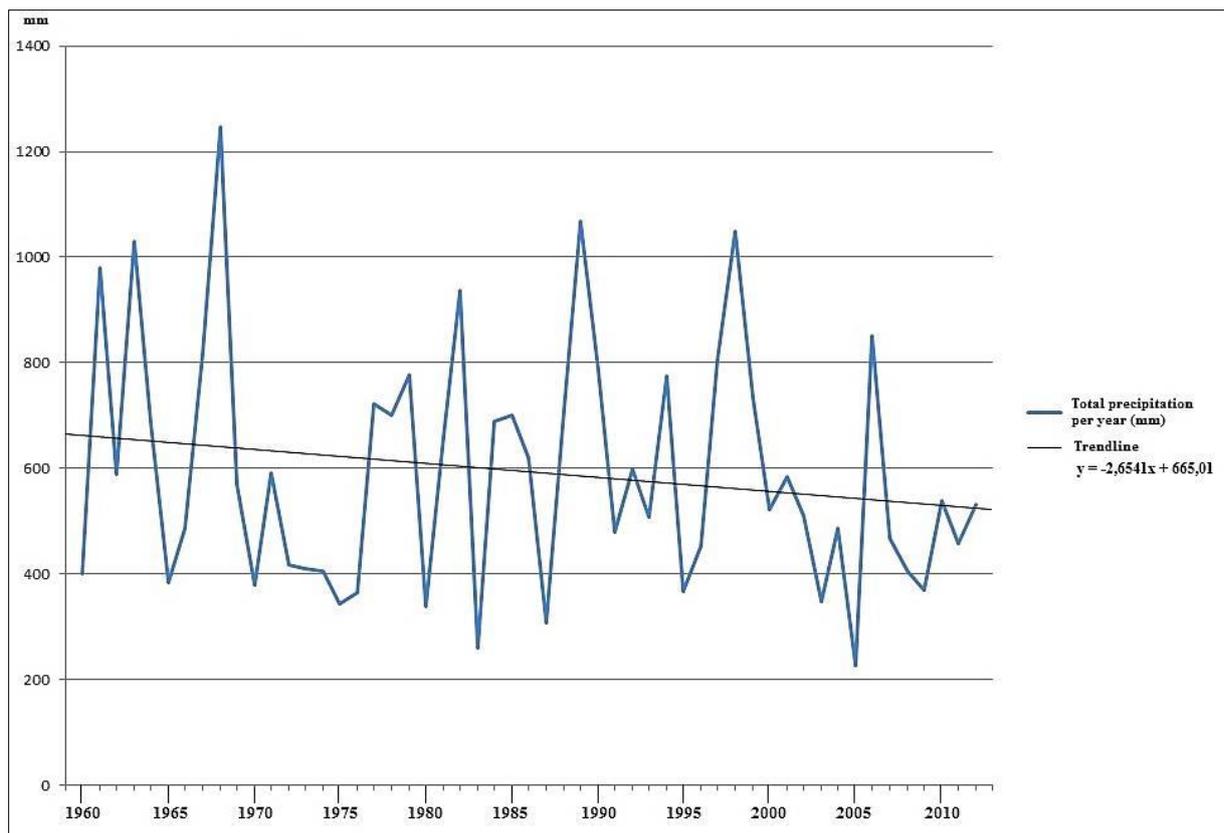


Figure 7: Total annual precipitation (mm), 1960-2012, Makindu Meteorological Station (Source: Kenya Meteorological Department).

The data also show a slight decline in rainfall in this period (see trendline in fig. 8). This trend corresponds with information provided by my informants during fieldwork in Ikisaya. My informants argued that they felt the climate in the area had changed since they were younger; the area was receiving less rain now compared to previously. For example, a 76-year-old man said in an interview; “*The climate in this area has changed completely. When I was young, we actually got a lot of rain, but nowadays, we get very little rain*”. This was also expressed during several informal conversations with people in the community. The overall trendline from rainfall in Makindu seems to support their argument (fig. 8). Some of my informants also said the frequency of droughts had increased since they were younger.

The concept ‘drought’ can however be defined in different ways. It is common to distinguish between meteorological, hydrological, agricultural and socio-economic drought. According to Glantz (1987), Mishra and Singh (2010) and Wilhite and Glantz (1985); *meteorological drought* is generally defined as a lack of precipitation, or a deficit of precipitation in comparison to average values, over a certain period of time. *Hydrological drought* generally

refers to a decline in surface and subsurface water resources below a predetermined level for a certain period of time. *Agricultural drought* usually refers to insufficient soil moisture to support crop growth and maturation, leading to crop failure. This is caused by a number of factors, such as lack of precipitation and high evapotranspiration. Finally, *socio-economic drought* refers to insufficient water supply to support the demand of socio-economic activities. These types of drought are interlinked and often coincide. For the purpose of this thesis, I will use a variant of the agricultural drought definition. Drought is here understood as; inadequate rainfall during a rainy season to support crop growth and maturation, leading to harvest failure. This is how my informants in Ikisaya commonly defined the concept of drought.

When I visited Ikisaya in October/November 2012, my informants said they were experiencing a drought. The short rainy season in May-March 2012 had been very poor, and most people said they had not harvested anything at all after that rainy season. This poor rainy season was according to my informants the latest in a series of several consecutive poor rainy seasons. Reports published by the Government of Kenya indicate that the area Ikisaya is located in received less than 50 percent of normal rainfall during four consecutive rainy seasons (table 5). These reports do not state what ‘normal’ amounts of rainfall in the area is, but is likely to refer to mean total annual or rainy season precipitation.

Year	Rainy Season	Amount of rain as percent of normal
2010	March-May	80-120 %
2010	October-December	Less than 50 %
2011	March-May	Less than 50 %
2011	October-December	Less than 50 %
2012	March-May	Less than 50 %

Table 4: Amount of rain as percent of normal rainfall amounts in the area Ikisaya is located in during the March-May and October-December rainy seasons, 2010-2012 (Republic of Kenya 2011a; Republic of Kenya 2011b; Republic of Kenya 2011c; Republic of Kenya 2012a; Republic of Kenya 2012b).

The records from Makindu Meteorological Station also demonstrate relatively low amounts of rainfall between 2006 and 2012 (fig. 7).

Not only did my informants complain about a general decline in rainfall and higher frequency of droughts, they also complained that the rainfall had become more erratic within the rainy

seasons. They said the rain could start off well, but then the rain could stop completely for a few weeks, and the crops would dry up in the fields. Erratic rainfall thus causes problems for crop growth and maturation. Although total amounts of rainfall within a year might be sufficient for agricultural production, the timing of the rainfall can cause harvest failures. Some of my informants also complained that the rainfall had become more localized. Some areas of Ikisaya could get sufficient rain for agricultural production during a rainy season, whilst other areas of Ikisaya could get insufficient rainfall amounts. For example, a 75-year-old man said; *“The rain has become a problem. It rains differently. It might rain in Ngovovoni¹², and then fail to rain in like Kyanzou¹³. It was not like that before... The rain only jokes with us now!”* Many of my informants also stated that they feel the temperature has increased in Ikisaya. For example, one female participant in a focus group interview said; *“It has become much hotter here. Before it was not as hot as it is now.”* The other participants agreed with her statement. I do not have meteorological data to confirm these three arguments; more erratic rainfall within the rainy seasons, more localized rainfall and higher temperatures.

My informants in Ikisaya hence feel that the area is receiving generally less rain, the rain has become more erratic, they experience more frequent droughts and they feel the temperatures have increased the last few decades. These perceived changes in the climate do not necessarily portray climatic trends in the area correctly. Humans do not remember the past as well as the near-past and present, and might perhaps glorify the past as compared to the present. “Human memory is not an exact reproduction of past experiences but is instead an imperfect process that is prone to various kinds of errors and distortions” (Schacter et al. 2011: 467). The answers I got when I asked my informants to compare past and present climatic conditions might also be colored by the present drought, and their frustration over several consecutive failed rainy seasons. Accurate or not; these perceived changes in the climate influence the adaptation strategies employed by people in Ikisaya.

5.1.1.2 Projected future changes in the climate

It is at this point not possible to assess whether the perceived and experienced changes in the climate in Ikisaya can be attributed to anthropogenic climate change, or if they are caused by natural climatic variability. Nevertheless, the higher temperatures experienced by my informants in Ikisaya are consistent with global and regional temperature trends the last

¹² A sub-village within Ikisaya, located around the market area (see map 4, page xiv).

¹³ Another sub-village within Ikisaya, located 4-5 km from the market area (same as above).

century. The Fourth Assessment Report of the IPCC demonstrate that global mean temperature increased with 0.74°C [0.57°C to 0.95°C] from 1850-1899 to 2001-2005 (IPCC 2007b). The report argue that the increase in temperature is very likely caused by human-induced increases in atmospheric greenhouse gases (IPCC 2007b). According to Hulme et al. (2001), both mean temperatures and annual precipitation in eastern Africa seem to have increased slightly between 1900 and 2000;

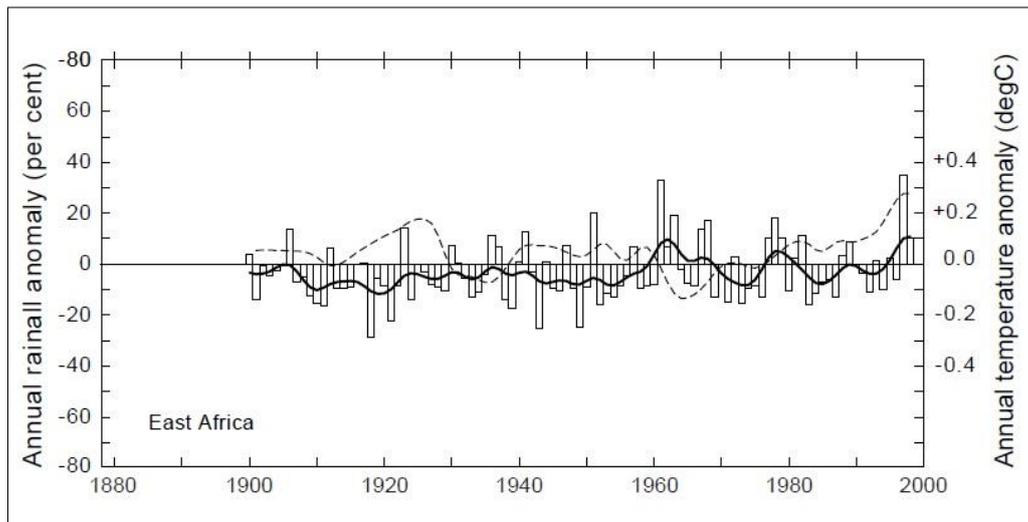


Figure 8: Annual rainfall (1900-98; histograms and bold line) and mean temperature anomalies (1901-98; dashed line), expressed with respect to the 1961-90 average (Hulme et al. 2001: 150)

Contrary to these findings from Hulme et.al, the rainfall data from Makindu meteorological station indicate a slight *reduction* in annual precipitation between 1960 and 2012 (fig. x). This illustrates climatic variations within the greater East African region.

Reliable projections of changes in the climate due to global warming currently only exist at the global and regional levels. It is therefore currently only possible to use climate projections on a larger scale to assess how the climate might come to change in Ikisaya. The IPCC argues that; “all of Africa is very likely to warm during this century. The warming is very likely to be larger than the global, annual mean warming throughout the continent and in all seasons, with drier subtropical regions warming more than the moister tropics” (Christensen et al. 2007: 866). James and Washington (2013) also argue that mean temperatures in Africa is projected to increase more than global mean temperatures.

Projecting changes in precipitation trends in Africa is generally more difficult than projecting changes in mean temperature (Boko et al. 2007). However, the IPCC projects a general

increase in annual mean precipitation in East Africa, with a higher increase in December, January and February than the other months (Christensen et al. 2007: 866). James and Washington (2013) projects that the October-December rains in East Africa will increase by 3 to 14 %, depending on the rate of global mean temperature increase (1-4 °C). Shongwe et al. (2010) projects that precipitation in Eastern Kenya will increase by 18 % in October to December and by 17 % in March to May, albeit the projections for the March-May rainy season is less certain than projections for the October-December rainy season.

Furthermore, anthropogenic climate change might cause more extreme weather. The IPCC asserts that; “a general increase in the intensity of high-rainfall events, associated in part with the increase in atmospheric water vapour, is expected in Africa, as in other regions” (Christensen et al. 2007: 871). Shongwe et al. (2010) also projects that high rainfall events are going to become more intense in East Africa. The IPCC further argues that; “There is *medium confidence* that droughts will intensify in the 21st century in some seasons and areas, due to reduced precipitation and/or increased evapotranspiration” (IPCC 2012). Higher temperatures might indirectly contribute to increased evapotranspiration, and thus exacerbate droughts caused by low precipitation. “Enhanced air temperature can indirectly lead to enhanced evaporative demand (through enhanced vapor pressure deficit), although enhanced wind speed or increased incoming radiation are generally more important factors” (IPCC 2012).

The IPCC also projects that rain-fed semi-arid agricultural systems in parts of East Africa might be negatively affected by climate change (Boko et al. 2007: 447). They argue that marginal areas such as semi-arid lands might become even more marginalized, and they project agricultural areas in arid and semiarid areas to undergo at least a 20 percent reduction in the length of the growing season by 2050 (Boko et al. 2007: 447). “Although the East African region as a whole may receive increased rainfall in future, global warming also increases climatic uncertainty at the local level and in the drylands, in terms of both seasonal shifts and the intensity and frequency of droughts” (Eriksen & Lind 2009: 821). Wolff et al. (2011: 743) also argue that global warming might have an impact on the El Niño Southern Oscillation (ENSO), and accordingly intensify the inter-annual variability of the rainfall in East Africa. “Warmer climate states appear to produce greater climate variability. This inference fits the growing consensus that current global warming will intensify the hydrological cycle, with wet regions and periods becoming wetter and dry regions and periods becoming drier” (Wolff et al. 2011: 747).

Projecting potential future impacts of climate change on Ikisaya is accordingly not an easy task. Nevertheless, climate change literature suggests that the temperature is likely going to continue to increase in Ikisaya. Higher temperatures might be harmful for agricultural production, and could increase water scarcity as it might increase evapotranspiration. With less certainty, Ikisaya might experience greater climate variability; an increase in the intensity of high-rainfall events; and perhaps more frequent and prolonged droughts.

The climatic factors that contribute to current vulnerability in Ikisaya is thus high inter-annual rainfall variability, erratic rain within the rainy seasons, frequent droughts, occasional floods and perhaps an overall decline in total annual rainfall amounts. Anthropogenic climate change might perhaps exacerbate these challenges.

5.1.2 Water scarcity

During the dry season, people in Ikisaya have very limited access to water. Water scarcity is generated by a combination of climatic, environmental and societal factors, such as low amounts of rainfall, high levels of run-off, and poorly developed groundwater extraction facilities such as boreholes. During the dry season, there is only one source of clean drinking water within Ikisaya; a water point located at Ikisaya market that draws water through a pipe from the Endau Hilltop. This water point is managed by a water committee. People have to pay 2 KSh¹⁴ per jerry can (20 liters) of water tapped at the water point, money that goes towards maintenance of the pipe and giving a small allowance to a water attendant who is responsible for allocating the water to customers. They follow a queue system at the water point; those who came first to the water point in the morning are given water first. When I visited Ikisaya in October 2012, every household was entitled to collect only 2 jerry cans of water (40 liters in total) per day from the water point. However, there was not enough water for everyone every day, so those who came too late, were not given anything. According to the chairman of the water committee, the water flows continuously through the pipe during the rainy season, and there is plenty of water for everyone, but during the dry season, not enough water comes through the pipe and the little water that comes must be rationed.

Water for livestock or other domestic purposes is collected from a few shallow wells. My informants said the water in these wells is not safe to drink, as the water is very salty. These wells are owned by the land owners themselves, according to customary laws, and other

¹⁴ 2 KSh = 0.03 USD (same as above)

people have to pay to draw water from them. This is more expensive than the water drawn from the water point in Ikisaya; normally they have to pay 5 KSh¹⁵ per jerry can of water (20 liters), or 5Ksh per head of livestock. According to an informant, there are only 10 such shallow wells within Ikisaya.

Fetching water is primarily done by women in Ikisaya. Most of the women I talked to said they went to the water point only every other day because of the long walk. Many have to walk for hours to get to the water point, some up to 4 hours each way. They often wait at the water point for hours before it is their turn to get water, and during the dry season they regularly have to go back home empty-handed due to the rationing. The water scarcity thus forces women to spend a lot of time looking for water during the dry season; time that could have been spent on doing income generating activities such as casual labor. Water scarcity contributes to increasing vulnerability for women, by restricting their options to gain an income and accumulate savings (Differential vulnerability caused by culturally ascribed gender roles will be further discussed in section 5.5.3).

In October 2012 they had started constructing two boreholes for extraction of water in Ikisaya; one located in Ngiluni and one near Kalwa. The construction of these boreholes is funded by Trocaire, a catholic aid organization. The completion of these two boreholes will improve the drinking water situation for many people in Ikisaya, but many told me this was not enough to solve the water scarcity problem during the dry season. People will still have to walk far to get drinking water, as the population is scattered over such a vast area.

5.1.3 Economic factors

Another issue identified by my informants as a threat to their well-being concerned income poverty, primarily caused by lack of employment options and frequent harvest failures. Most of the inhabitants in Ikisaya are poor farmers who depend on rain-fed agriculture and livestock-keeping, which are highly climate sensitive livelihoods. Very few have formal employment. The formal employment options in Ikisaya are restricted to the two primary schools, the Ikisaya Energy Centre, and the local administration. Emigration to towns and cities such as Nairobi and Mombasa in search for formal employment is common in the area, especially among educated men. Casual employment is another common source of income, while some have different kinds of businesses, such as fixing bicycles, selling livestock at the

¹⁵ 5 KSh = 0.08 USD (Exchange rate: 0.0151, per 07.05.13).

market in Endau, or operating shops or restaurants. All these sources of income are undependable, and highly irregular throughout the year. The income is also generally very low.

Income poverty rates in Ikisaya are therefore relatively high; approximately 58 percent of the people in the sub-location lived below the poverty line in 1999 (Eriksen & Lind 2009). According to Kenya National Bureau of Statistics (2007), 63,7 % of the population in Kitui, the county Ikisaya belongs to, lived below the income poverty line of 1.562 KSh¹⁶ (per person per month) in 2005/2006. These figures are probably representative of overall income poverty levels in Ikisaya.

Income poverty in Ikisaya is highest towards the end of the dry seasons and especially high during prolonged droughts, as the main source of income for the majority of the people is selling crops. However, if the rain has been poor, they get minimal or no income from their agriculture, and they are forced to buy all the food they consume. Furthermore, the price of food, especially maize, sold at the market and in shops increase remarkably during droughts, due to higher demand and lower supply. Therefore, as observed elsewhere in Kitui county, the “prices of food reinforce the effects of poor harvests. As more and more households are forced to buy food, the prices of maize and other forms of food tend to rise unless the supply of food from other regions increases” (Eriksen 2005: 252). My informants said the price of maize in the area had tripled in October 2012 compared to the normal rainy season price. A shop owner in Ikisaya told me that during the rainy season, one kilogram of maize was sold for 10 KSh¹⁷, while in October 2012 one kilogram of maize was sold for 35-40 KSh¹⁸. An informant summarized this problem by saying; “*When the drought comes, the food price goes higher. People are very poor, they don't have money to buy food for their families*”.

When I visited Ikisaya in October 2012, almost all of my informants said they had to buy all of the food they consumed. Many of them had not harvested anything at all after the last rainy season and had been forced to buy food for several months, while those who had harvested something had exhausted their food stocks already in June and July the same years. Almost all of my informants said that they could not afford to buy sufficient amounts of food for their families. They therefore had to ration and reduce the amount of the food consumed. According to a nurse at the dispensary in Endau, malnourishment increased considerably

¹⁶ 1.562,00 = 23 USD (Exchange rate: 0.0151, per 07.05.13).

¹⁷ 10 KSh = 0,10 USD (Exchange rate: 0.0151, per 07.05.13).

¹⁸ 35 - 40 KSh = 0,53 - 0,60 USD (same as above).

during the dry seasons in the area. Children under the age of five were by her considered to be the worst affected by the combination of harvest failures, high income poverty levels and high food prices.

It would appear that low and erratic rainfall traps some people in Ikisaya in a ‘vicious cycle of poverty’. Insufficient and erratic rainfall during the rainy season leads to poor harvests, and forces people to consume all of the food they harvested themselves. Once their own stock of food is exhausted, they have to buy expensive food at the market or in the shops. They will accordingly spend their savings on buying food, and might be unable to buy enough new seeds for planting the next rainy season. They will therefore harvest less the following season, and get an even lower income from farming the next season. Several consecutive failed rainy seasons thus exacerbate income poverty, which in turn might lead to food insecurity and malnourishment.

Very few people in Ikisaya keep savings of money. Only four of my 50 informants said they had savings, 3 of which kept the savings in a bank account. These four were male. The rest of my informants said they hardly had enough money to buy enough food for their family on a day-by-day basis, and therefore had nothing to save. This illustrates how poverty hampers the ability to invest in longer-term adjustments to climate variability and change for the majority of people in the village.

Further, people in the area lack access to insurance schemes. In wealthy countries like Norway for example, farmers can buy insurances that will compensate losses from harvest failure. Although index-based insurance schemes are being developed for farmers in poor countries (Barnett et al. 2008; Mutsaers et al. 2011), such kinds of insurances are currently not available to farmers in Ikisaya. If their harvest fails, they will simply not have any income from their farming that season. This makes the farmers, who rely on rain-fed agriculture, highly vulnerable to climatic conditions. Low and erratic rainfall put farmers into destitution, and reduces their ability to invest in adaptive measures.

Access to credit and loans have previously been practically non-existent for people in Ikisaya, but today women are able to apply for loans from the microcredit institution Kenya Women Finance Trust (KWFT)¹⁹. According to a member of the KWFT in Ikisaya, loans from KWFT are only open to women, and they have to become a member to apply for a loan. The

¹⁹ For more information see: www.kwft.org

membership fee is 250Ksh, non-refundable. In order to get a loan, the woman has to put down something as a security, an item she can sell if she fails to pay the debt. She also needs to have a guarantor that will pay the debt if she is unable to. The items people normally put down as security is goats, donkeys, cows, ploughs or wheelbarrows, and the guarantor is normally a relative. Women normally loan money to pay school fees for their children or to open a small business. One of my key informants said the KWFT has been a great success. *“It has helped us a lot. It has helped women to educate their children. And to carry on their small businesses...To most of the women, capital has been the problem... so if a mother is able to access finances, or a loan, she will not be a bother to the husband”*.

Many of my informants said they had gotten loans from KWFT for various purposes, and said they were grateful they had this opportunity. However, quite a few said they had never applied for a loan because they feared they would not be able to pay it back because they had no money. Some of these were single mothers who did not have anyone to put down as a guarantor, and did not have a steady income. It seemed to me like some of the women who do get loans from KWFT get help from their husband to pay back the loan. For example, a male informant said *he and his wife* had borrowed 50,000 KSh from KWFT to pay school fees. He said *he* paid 5,000 KSh at the end of each month on the loan. This might indicate that access to loans is more restricted for the female-headed households.

It is more difficult for men to get a loan in Ikisaya, as they have to apply for a loan in a commercial bank. Generally only those who keep savings in a bank are able to get a loan, and as mentioned earlier, very few people have enough money to keep savings in the bank. Only three of my male informants said they had ever borrowed money from a bank, and they had spent it on starting some kind of a business. These three all had savings in the bank, and seemed to be relatively well-off.

5.1.4 Politics and infrastructure

National and local political issues also contribute to vulnerability in Ikisaya. The drylands of Kenya, where Ikisaya is located, have been somewhat neglected by the central government in the past. According to Eriksen and Lind (2009: 821), there has been “a consistent development bias in Kenya that has favored regions with greater potential over drylands”. “The drylands have been seen as having low economic potential and being politically unimportant. As a result, government allocations for development in the drylands have often

been low” (Owuor et al. 2011: 52). There has therefore been very little provision of infrastructure and public services, such as schools and health clinics, and very few development projects in the Ikisaya area. However, recent political changes, such as democratization and decentralization of the government, have led to an increase in investments in development projects (Eriksen & Lind 2009; Owuor et al. 2011). Yet, most of the recent development projects in Ikisaya have been provided and funded by various Non-Governmental Organizations, such as the drilling of boreholes.

The Constituency Development Funds (CDF) at the district levels in Kenya are responsible for allocating development funding to sub-locational levels. According to Kenya Open Data²⁰, the CDF in Kitui only funded one development project in Ikisaya between 2003 and 2010; construction of a polytechnic school. This was confirmed by the sub-chief in Ikisaya. The CDF provided with 450.000 KSh between 2004 and 2008 to this polytechnic school. However, according to the sub-chief in Ikisaya, this was not enough to operate the school on a long-term basis, and they had to close down the school in 2012.

The infrastructure in Ikisaya is poorly developed. The dirt road becomes practically impassable during the rainy season, due to flooding and thick mud. The unpaved road has also been heavily affected by erosion in some places. The responsibility for maintaining the roads lies with the government. The sub-chief in Ikisaya said they had been requesting the government for modern roads for years, but the government has so far not prioritized to allocate money to improve infrastructure in the area.

Provision of public health services to people in Ikisaya is also scarce. There are no dispensaries or hospitals in Ikisaya. The closest dispensaries are located in Malalani and Endau, located respectively 8 and 10 km from Ikisaya market. The closest hospital is located in Kitui town; approximately 45 km from Ikisaya (see locations on map 2, page xiii). The dispensaries provide only very basic health services, such as delivering babies, prescribing medication and treat simple illnesses, vaccinating children, providing free contraceptives and giving advice on family planning. The dispensaries cannot do any surgeries; they do not have anti-venom for snakebites and so forth. For more serious injuries and illnesses, the patients therefore need to travel all the way to Kitui.

²⁰ <https://opendata.go.ke/Public-Finance/Constituency-Development-Fund-2003-2010-/6npe-zx95>

Access to health services is further constrained by limited transportation options and poorly developed road infrastructure. The dispensaries in Endau and Malalani do not have vehicles to collect patients, so the patients need to travel there on their own. The patients therefore have to travel to the dispensaries on foot, by bicycle or bus. Some very few have their own motorbike. Nobody in Ikisaya owns a car. The bus that goes past Endau, Ikisaya and Malalani goes only once a day in each direction. The problem of transportation is further aggravated during the rainy season when the roads are impassable. Travelling to the dispensaries is therefore normally very time-consuming and expensive for people in Ikisaya, and in the case of acute illness or accidents, getting to the dispensary or the hospital in time might be practically impossible. Illnesses and accidents that would otherwise be harmless can therefore, as a result of poor infrastructure and lack of transportation options, become detrimental for people in Ikisaya. For example, even though it is possible to give birth at the dispensary, most women in Ikisaya deliver their babies at home because of the distance and cost of going to the dispensary. However, if complications occur during delivery, the women might not reach the dispensary or hospital rapidly enough.

As a result of the deficient development funding to the area, many of my informants argued that they felt the politicians had ‘forgotten’ Ikisaya. During my fieldwork in Ikisaya, many people displayed a lack of confidence in both national and local politicians. Many talked about widespread corruption in Kenyan politics, and said that the politicians were only concerned with enriching themselves and their families. A man from Ikisaya told me during an informal conversation that politicians gave a lot of promises during political campaigns, but as soon as they were elected, they ‘forgot’ their promises, became greedy and neglected their constituents. Promises of development funding are used to mobilize political support during political campaigns (Owuor et al. 2011), but they are not always followed through. One key informant told me; *“We don’t have that big influence to politics... We don’t see any great impact of the politics in our area. We have elected the current MP [Member of Parliament], we have elected him for the last 10 years, but we don’t have any touchable thing that we can say he has done for us”*.

When it comes to politics at the local level, so-called ‘Development Committees’ are responsible for identifying needs of their area and forwarding these needs to higher levels of governance. These development committees are however sensitive to social inequality and power relations at the local level, as the needs of some people might be prioritized over the needs of marginalized people. For example, people belonging to minority clans and

uneducated people seem to have a lesser say in political decisions than educated people belonging to the majority clans (this will be discussed in greater detail in section 5.5). Local politics might therefore be influenced by social structures in the community, and decisions made by the development committee can make marginalized people even more vulnerable by neglecting their interests.

5.1.4.1 Forest conservation policies: the Endau hilltop

Another political issue that contributes to vulnerability in Ikisaya concerns the political decision to protect the Endau Hilltop forest. Ikisaya is located on dry plains at the foot of the Endau hills; a mountain forest area of which the highest peak is at 1337 masl. The Endau hilltop has a cooler and wetter climate than that on the plains surrounding the forest, and is therefore a source of resources such as water, pasture, timber, animals, fruits and plants (Eriksen & Lind 2009; Owuor et al. 2005).

In 1930, Kamba farmers settled on the sloping hills of the Endau hilltop forest, and started to cultivate crops in the favorable climate. However, in 1948, the British colonial government decided to protect the hilltop forest, and evicted the farmers from the hill (Lind & Eriksen 2005). After independence, the forest remained gazetted for conservation and owned by the government, but some farmers moved back up to the hills. In the 1990s, the forest department became concerned that the forest was being cleared by the locals, and the settlers were once again evicted in 1996. Access to the hill by the villagers was also made in practice illegal (Eriksen & Lind 2009; Lind & Eriksen 2005; Owuor et al. 2005).



Map 5: Endau hilltop area, indicating location of Ikisaya (Google Earth).

Three of my informants told me that they were born uphill, but had been forced to move down to Ikisaya. They received no compensation from the Government of Kenya for being forcefully evicted from their homes in the hills. These three people were fortunate to have access to land on the plains in Ikisaya, but some of the people that were evicted from the hilltop forest did not have access to land elsewhere. The eviction thus caused several people to become landless (Lind & Eriksen 2005).

According to the sub-chief of Ikisaya, the Endau hilltop forest is still government land, and it is illegal for people to go to the hill to do hunting, farming, graze livestock or to cut down trees to make charcoal. If they do, and are caught, they risk being taken to court and fined. Many of my informants said they find it problematic that they are not allowed to access resources in the forest, especially during droughts. The forest protection policy thus contributes to vulnerability in Ikisaya by limiting access to forest resources that could improve access to food and income during the dry seasons and prolonged drought.

5.1.5 Conflict and tensions

Another issue that contributes to vulnerability in the Ikisaya area concerns the tensions between the settled Kamba population and nomadic pastoralists from other tribes. These

tensions occasionally culminate in violence, inhibit seasonal movement of livestock, and contribute to internal divisions within the Kamba population.

The Kamba people have been living in the area around Endau hill since the late 19th century, when the Kambas settled in the area after fighting and displacing the Akavis, a pastoralist group related to the Maasai ethnic group (Eriksen & Lind 2009). Kamba pastoralists from other areas of Kenya and pastoralists from two other ethnic groups; the Kenyan Somali²¹ and the Orma²², seasonally migrate to the area with their livestock to access water and pasture, as well as to trade (Owuor et al. 2005). In the 1970s, raiding of cattle in the rainy-season grazing areas shared among pastoralists from the Kamba, Orma, and Kenyan Somali ethnic groups started. This ‘dispute’ between the different ethnic groups in the area culminated in the early 1990s, when pastoralists from the Orma and Kenyan Somali groups raided livestock, household property, and businesses in Kamba settlements surrounding the Endau hill. These raids affected the villages of Twambui and Malalani more than Ikisaya, but the violent raids in the 1990s also led to loss of livestock and lives, closure of the school, in-migration of people from Twambui and Malalani and disruption of farming in Ikisaya (Eriksen & Lind 2009).

Smaller-scale raiding and thefts continued in the area until 1999, but during the 2000s the Orma and Kenyan Somali groups started migrating regularly to Twambui and Malalani during the dry season to rent access water and grazing for their cattle and camels, and to buy food and household necessities in the shops (Eriksen & Lind 2009). This trade between settled Kamba agropastoralists and the nomadic Kenyan Somali and Orma pastoralists in the area around Endau hill also led to tensions within the Kamba group. The owners of shallow wells that rented out access to water benefited from this trade with the Orma and Somali pastoralists, as the renting-out of water provided them with a much needed extra income during prolonged dry seasons. The shop-owners also benefited from their presence. However, “The attacks in the 1990s had led to distrust and a feeling that current pastoralist presence and trade made the area unsafe” (Eriksen & Lind 2009: 825). The trade with the Orma and Somali pastoralists therefore led to internal tensions within the settled Kamba community between those who benefited, and those who did not benefit from the trade. The issue became highly politicized in 2006 and 2007, when some politicians, in attempts to win political support, publicly argued

²¹ The Kenyan Somali is a Muslim, Cushitic, ethnic group that entered into Northern Kenya from Somalia at the end of the 1800s (Lochery 2012).

²² The Orma is also a Cushitic ethnic group, originating from Ethiopia. The Orma are predominantly pastoralists, and most of them are Muslim (Irungu 2000).

that the trade should be stopped and Somali and Orma pastoralists should be excluded from the area. Their argument was based on the notion that Kitui County is only for Kamba people, and people of Somali and Orma ethnic origin should therefore not be allowed into Kitui without a government permit (Eriksen & Lind 2009). Trading with Somali and Orma pastoralists was subsequently banned in Twambui in 2006, and the Somalis and Ormas were restricted to enter the Malalani area in 2006 and 2007 (Eriksen & Lind 2009).

The dispute between the Kamba and the Kenyan Somali ethnic groups culminated again during the summer of 2012, triggered by the killing of a Kamba man from Ikisaya by Somali pastoralists on July 5th. I was told by my informants that this man from Ikisaya had gone to look for his cattle that were grazing in an area close to Twambui, when he met a group of Somali pastoralists that shot him. The Kamba man was allegedly unarmed. Afterwards, some young Kamba men chased the Somali pastoralists, and killed them with bows and arrows. When I visited Ikisaya in October 2012, most of the people, especially women, said they were worried that the Kenyan Somalis would retaliate and revenge this attack by coming to the area and kill people, raid their homes and steal their livestock. Many people said they did not want to bring their livestock to graze on pastures farther from the village, as they were worried they might run into the Kenyan Somali pastoralists there. One of my informants said that most of the people in Ikisaya had taken their livestock to graze farther away from the village in June 2012, but they returned after the man was shot on July 5th. She said it was a problem that they could not bring their livestock to pastures farther away, because the pasture closer to the village was not sufficient for their livestock. The ‘dispute’ therefore inhibited the seasonal movement of livestock in Ikisaya.

During my fieldwork, I talked to many people about the ‘conflict’ with the nomadic pastoralists, but I noticed after a while that they were all talking about the Kenyan Somali pastoralists, and never the Orma pastoralists. I therefore asked some people how their relationship was with the Orma compared to the Kenyan Somali. One man told me that they only had a problem with the Kenyan Somali, not with the Orma. He said that the Kenyan Somali were now disturbing, fighting and raiding both the Orma and the Kamba. Discussions I had with people in Ikisaya indicated that dynamics of the ‘dispute’ in the area have shifted somewhat in recent years, into a situation where the Kenyan Somali pastoralists are seen by the Kamba as the ‘enemy’, while the Orma are more or less considered to be their ‘allies’.

In general, the people in Ikisaya expressed very strong negative sentiments about the Kenyan Somalis, as clearly evident in what a man answered when I asked him about the Kenyan Somali pastoralists;

The Somalis? We don't call them the Somalis. We call them the Bandits. The bad people. Those people are very bad. They kill us for nothing! ... You know, the Kamba people are good people, but the Somalis think we are stupid people for letting them come here to our land, they are doing a lot of mockery... They kill us, harass us, chase us away, liaising with maybe some few people, some naughty boys over here, our naughty boys, they liaison with them. They come here, threaten us, they kill us, they do bad things... Those guys over there, I think I can say, they feel that they are not from Kenya, they are from maybe Somalia.

These negative attitudes towards the Kenyan Somalis should be understood in light of historical events and national politics. I will therefore provide a very brief and somewhat simplified outline of events that might illuminate the sentiments towards Kenyan Somali pastoralists in Ikisaya.

In 1960, during British colonial rule, some groups in the (then called) Northern Frontier District (NFD) of Kenya started campaigning for “secession of the NFD from Kenya to the Somali Republic” (Whittaker 2012: 391). “The demand for NFD secession was supported by the government of the Somali Republic, which was also campaigning for the creation of a ‘Greater Somali’ state, the unification of all Somali inhabited territories across the Horn of Africa” (Whittaker 2012: 392). However, when Kenya gained independence in 1963, the new Kenyan government refused NFD secession and included the region into the Republic of Kenya. This led to protests and a series of violent attacks on police posts and administrative camps in northern Kenya on December 12th 1963. This marked the start of the so-called *Shifita* conflict in Kenya; a conflict that lasted until 1967 (Whittaker 2012). The term ‘shifita’ means bandit or rebel, and “in Kenya it has most frequently been applied to criminal bandit gangs engaged in livestock raiding and poaching” (Whittaker 2012: 394). The ‘shifita’ term was in the 1960s used when referring to those who took up arms and engaged in violence against the government of Kenya during the struggle for secession in northern Kenya (Whittaker 2012).

Then on October 16th, 2011, Kenya initiated a military operation against the terrorist group al Shabaab in southern Somalia. According to Throup (2012); “While the ostensible catalyst for the intervention was a spate of high-profile cross-border kidnappings and murders by freelance Somali criminals, a longer-term set of ambitions and objectives underlay the

operation”, such as concerns about the influx of Somali refugees into Kenya and a deteriorating security situation in northern Kenya. A number of terrorist attacks and kidnappings in Kenya have been blamed on al Shabaab since the launch of their intervention in 2011, such as attacks on two churches in Garissa in July 2012 (Gettleman 2012). As a consequence of these attacks and the Kenya military operation in Somalia, Wambua-Soi (2012) argue that; “Some in Kenya are translating the war on al-Shabab as a war on Somalis”. She further argues that she has noticed a growing xenophobia²³ against Somalis in Kenya, both against recent refugees and Kenyan Somalis (Wambua-Soi 2012).

The negative sentiments against the Kenyan Somali pastoralists displayed by the people I talked to in Ikisaya, should be seen in relation to this context. The Kamba people in Ikisaya had very strong opinions about the Somali people in general, and did not seem to differentiate between the Kenyan Somali pastoralists and al Shabaab militants in Somalia. In an informal conversation, a man said to me that “*all Somalis are evil people*”. Most people consistently referred to Somali people as ‘shiftas’ or ‘bandits’, echoing the rhetoric used during the Shifta conflict in the 1960s. The negative sentiments towards Somalis in Ikisaya also had a religious undertone; many people said outright that they did not like Muslims. Furthermore, the attitudes towards the Kenyan Somali pastoralists in Ikisaya was linked to the notion of ‘autochthony’; a notion holding that a people is entitled to a certain piece of land because of their ancestral rights to that land (Bøås & Dunn 2013). During another informal discussion, a woman in Ikisaya said; “*The Somalis should not come here to this area. This is Kamba land – for Kamba people only*”.

One of my key informants argued that the ‘dispute’ between the settled population and the nomadic pastoralists is a result of water scarcity. The nomadic pastoralists migrate to the area with their livestock in the dry season to look for water, but there is hardly enough water for the local livestock, much less to share with the nomadic pastoralists as well. However, I think framing this as merely an environmental dispute masks important aspects of the dispute dynamics; linkages to international and national politics, the notion of autochthony, and xenophobia. I fear that growing xenophobia, or anti-Somali and anti-Muslim sentiments, and claims to autochthony might further fuel the already tense relationship between settled Kamba agropastoralists and nomadic Kenyan Somali pastoralists in the Ikisaya area in the coming future. This could have implications for vulnerability.

²³ The term ‘Xenophobia’ refers to “extreme dislike or fear of foreigners, their customs, their religions, etc.” (Cambridge Dictionaries Online 2013).

5.1.6 Socio-cultural dynamics

In addition to the above-mentioned climatic, economic and political factors, socio-cultural dynamics also shape the vulnerability context in Ikisaya. This section will discuss how socio-cultural dynamics related to the clan system; socio-economic status and gender contribute to inequity and power asymmetries, which in turn might cause differential vulnerability within the community.

5.1.6.1 The clan system

The Kamba tribe is divided into clans. The clans “function as an informal institution, consisting of pronounced social networks based on marital linkages” (Owuor et al. 2005). The clans are patrilineal; such that upon marriage, the wife becomes a member of the husbands’ clan (Middleton & Kershaw 1965). Their children also become part of the fathers’ clan. Clan members have certain duties of assistance towards each other (Middleton & Kershaw 1965).

The relationship between the clans in Ikisaya is generally peaceful, but according to my informants there are some tensions between certain clans. For example, a female informant said; *“Some clans are friendly, but some clans are in conflict with other clans. Or within one clan, there can be conflict between different families. Because in one clan there are many families and these families can be in conflict with each other”*. The clans are of varying size, and the size greatly determines the relative power or dominance of the clan within a community (Middleton & Kershaw 1965; Owuor et al. 2005). In Ikisaya there are about 11 clans. The three biggest clans are according to my informants the Mwathi, Munzauni and Kanyaa. One informant told me that the asymmetric power of clans is sometimes problematic for local decision-making processes;

In development, that is a problem. Because the big clans, like the Mwathi, they are so many. So if the community is to vote on something, the Mwathi will take all the votes. So everything is dominated by Mwathis. And those many can make something fall. If they don't like something, they are so many that they can destroy it.

Asymmetric power relations and tensions based on clan affiliation might therefore marginalize some people in decision-making processes, leading to neglect of their interests.

5.1.6.2 Socio-economic status

Educated people seem to have a relatively higher status and power in the community of Ikisaya. For example, an elderly, uneducated man said;

When I grew up and became a mature person, people were very kind to one another. But when the people started learning and getting education... they started to change. They started to have differences like "I'm learned, you are not learned". And we started to have these groups which were learned, and those who were not learned. They started a difference.

He argued further that the educated and literate people now dominate public meetings in the community. During these meetings, the opinions of uneducated, illiterate people are ignored; *"If I want to ask anything, a question, or bring an agenda, this agenda will not be valued. It will not be of importance. It will just be ignored"*. Educated people therefore seem to have greater say in the decision-making process in Ikisaya.

Primary education is free and compulsory in Kenya (Republic of Kenya 2010), but secondary and higher education is relatively expensive and therefore primarily confined to richer families. Most of the educated people in Ikisaya accordingly come from comparatively rich families. The higher status of educated people is therefore also related to socio-economic inequality.

Some of my informants referred to 'the elite' in the village; relatively wealthy people who had high education and spoke English. Some of these had lived outside of Ikisaya for a while, for example to work in Nairobi or Mombasa. These 'elites' were primarily male, but there were also some women in this group of people. These people seemed to be quite powerful in decision-making processes in the village and held important positions in for example the 'village elders' group. As mentioned above, illiterate people felt their interests were somewhat ignored, for example during public meetings. This power asymmetry was somehow also evident in the way the 'elites' referred to lower-status people in the community with a degree of disrespect. For One of my key informants said that the *"majority of people here are not well educated. Most of them are semi-illiterate, they just went up to standard 8 maybe. So the reasoning of such a person, the way of doing things, are a bit [paused] not that good"*. Another key informant referred to illiterate people as the 'lower class'. The richer, educated people thus seem to have higher status in the community, and have greater influence in politics and community level decision-making.

5.1.6.3 Gender relations

Ikisaya is a fairly male dominated patriarchal society. In Kamba societies in general, men are the heads of households, and have an authoritarian position in the family. This cultural practice has according to Miller, Ann Neville et al. (2009) deep traditional roots. The role of women in the Kamba tribe has traditionally been to “serve their husband, children, and clan in the manner that their husbands saw fit” (Miller, Ann Neville et al. 2009: 52). In general, Kamba women often have fewer privileges and options than Kamba men do, as a result of traditional cultural practices (Miller, Ann Neville et al. 2009). My informants referred to ‘the Kamba law’, a customary law system, to explain the set of norms governing gender relations in the community. Gender relations in Ikisaya are also influenced by religion. Virtually everyone in the area belongs to the Christian faith. There are three churches only within Ikisaya; the Catholic Church, the African Inland Church (AIC) and the Redeemed Gospel Church, and most people go to church every Sunday. The Christian faith pervades the culture and social life in Ikisaya, and the position of women in society and within the family is influenced by quite conservative Christian tenets.

Culturally and religiously ascribed gender roles influence the distribution of labor in Ikisaya. Women are primarily responsible for fetching water, collecting firewood, cooking, taking care of children and doing domestic work such as doing laundry and washing dishes. Men are primarily responsible for doing wage labor and looking after livestock. Men therefore generally generate the income in a household, and share this with his wife. Women accordingly have less financial freedom than men. Some of my female informants complained that their husbands were spending too much money on alcohol, and then giving them too little money to buy food and paying school fees.

During droughts, women’s workload increases considerably, as they need to go further from their home and spend more time on fetching water. This reduces the time women have available for income generating activities. I asked some women during a focus group discussion why women are responsible for fetching water for the family. One of the women answered; *“According to our culture, a woman has no authority to tell a man to fetch water. So it is the responsibility of a woman to fetch water and to look after the children”*. The other women in the group nodded and agreed with this statement. I asked them what would happen if a wife told her husband “I will not get water today. You have to do it.” The women laughed

at my question, and answered that if she said that to her husband, the man would not accept to go, and he might leave her.

According to a key informant, land in Ikisaya is owned according to customary laws by the heads of households. The ‘heads’ are normally the eldest male in the household. Upon marriage, the wife move from her own family’s house to the husband’s house. If they later get divorced or separated, the woman either has to move back to her family, remarry or buy land elsewhere and build a new house. However, according to my informants, very few women in the community remarry after a divorce or separation (while most men do). It seemed to me that cultural norms proscribe women from remarrying. For example, I asked a female informant who was a widower if she would get married again. She just answered; “*No. I can’t.*” Furthermore, women seldom have sufficient amounts of savings to afford buying land themselves. Divorce and separations are therefore unfavorable to women, due to the traditional labor distribution pattern and customary land right system.

There are however fairly many *de facto* female-headed households in Ikisaya, primarily as a result of male emigration. As there are very few formal employment options within Ikisaya, educated men normally move elsewhere in search for a job. This pattern is visible in the distribution of marital status among my respondents in this study;

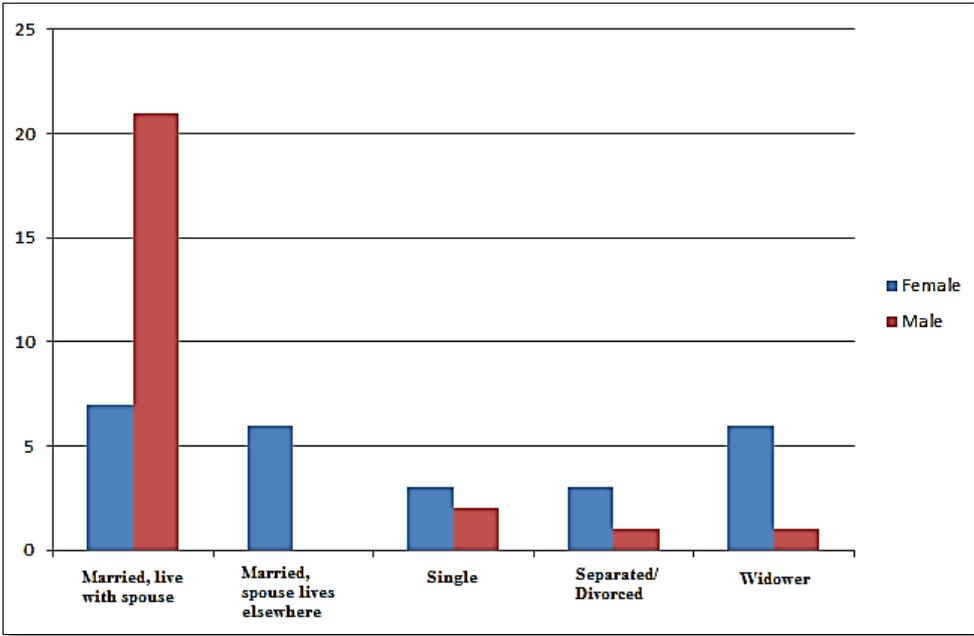


Figure 9: Marital status of respondents in this study (n=50).

When the husbands move for employment, women are dependent on either getting remittances from the husband, or generating an income themselves. However, according to my informants, the amount of remittances women get from their husbands varies to a great extent. Some get remittances from their husbands on a regular basis, while others get practically nothing.

It is also fairly common in Ikisaya for unmarried women to have several children, in spite of never having been married. For example, a female informant told me she had never been married, but she had ten children. I asked her if she got any help or support from the father of her children. She answered; “*No. He went away*”.

Single female-headed households were considered by many of my respondents to be the most negatively affected by drought and climate variability in Ikisaya, as they were the sole breadwinners of their family. For example, upon asking a question about who in the community is affected the most by drought, a key informant said;

I would say the single headed families, especially female ones, to some extent are affected by drought. Because when there is drought, it means less water, less food. So there she is, with her children, nobody is assisting her in looking for food for her children. Harvest is not there. Maybe the lady is not working anywhere. So there she is, with no source of income, and no food from the shamba²⁴. So to some extent, they suffer. Unlike other families where their husbands, maybe the men are struggling, maybe doing hard jobs, so as to at least earn something for their families. The women may not be able to do hard jobs to earn a living.

Gender inequity is also reflected in educational levels in Ikisaya; women generally have lower educational level than their male counterparts. As mentioned in the previous section, primary education is now free and compulsory in Kenya. However, secondary education is quite expensive, and fewer women than men have secondary and higher education in Ikisaya. There is therefore a gender gap in secondary and higher education in Ikisaya. This is consistent with a study of gender differences in dropout rates in the Kenyan school system by Lloyd et al. (2000). They found that the gender gap appears in the teenage years; in rural areas of Kenya more girls than boys drop out during the last years of primary school and in the transition from primary school to secondary school.

²⁴ The word ‘Shamba’ is used to refer to a cultivated plot of land in Kikamba.

This issue is clearly visible in the educational levels of my respondents. While 40 per cent of my male respondents had secondary school education, none of my female respondents had higher education than primary school. 48 per cent of my female respondents had not gone to school at all, in comparison only 8 per cent of the male respondents had never gone to school;

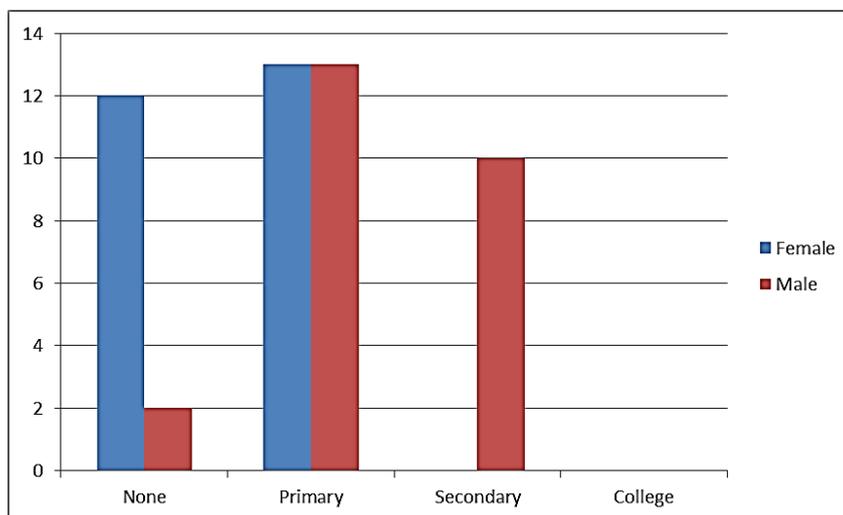


Figure 10: Educational level of respondents in this study, indicating gender differences ($n=50$).

I did not inquire more about the reasons behind this gender gap, but I got the impression that one of the reasons why women in Ikisaya generally have lower education than men is that women often get married and have children when they are fairly young, and then discontinue their education. Furthermore, as women are traditionally ‘supposed’ to stay at home and take care of their family, it seems likely that families rather invest in educating their male children, as they are perhaps more likely to pursue formal employment. Regardless of reasons behind the gender gap in educational level in Ikisaya, the lower level of education among women might have consequences for their vulnerability relative to men. Uneducated women have a lower chance of getting formal employment than educated women, and are thus reliant on unstable, informal sources of income.

The spread of HIV/Aids is also associated with gender relations in the area. One of my key informants argued that one of the reasons behind the spread of HIV is extra-marital affairs. She argued that men in the area develop a habit of going outside the marriage after they get married; *“Because when he has got a woman at home, then he starts loitering, finding others, doing adventurous things with small, small girls. They are fond of that. That’s why it is the married people who are the ones who are infected [by HIV]”*. I asked her if it is common for women in the area to have extra-marital affairs as well. She said; *“Women in this area have a*

fear of going outside marriage, they have fear. They normally stay with their man. Because once you are caught outside, you can be beaten. You can be beaten even to the extent of going to the hospital in a coma!”

I asked some women in a focus group discussion what would happen if a woman discovered that her husband had given them HIV. They said; *“After they know that the husband has brought the disease home, they don’t react, because the disease has already been brought, so even if you react, there is no solution. They do stay with that man.”* I then asked what would happen if it was the other way around; if a husband discovered that his wife had given him HIV. They answered; *“If the man knows that you have brought the disease, that man can be very violent, and he can chase you away from the house”.*

5.2 Responses to drivers of vulnerability

5.2.1 Coping strategies

People in Ikisaya employ a variety of strategies to cope with challenges and threats to their livelihoods. These enable them to acquire food and income during periods of stress. As explained earlier in this thesis, almost everyone in Ikisaya is engaged in agriculture and relies on their harvest as the main source of food and income. When the harvest fails due to insufficient rain, the farmers have to rely on other sources of food or income. As previously observed elsewhere in the country, the activities, or coping strategies, they then employ are not necessarily confined to periods of drought, but they are normally intensified in these periods (Eriksen 2005). The coping strategies generally provide households with very little food or money, and many households have to engage in several activities at the same time. Coping strategies are therefore interconnected (Eriksen 2005). However, some of these coping strategies are actually illegal activities, and people engaging in these activities risk being subjected to heavy fines or imprisonment.

My informants reported that they engaged in a variety of activities to acquire food or income when I visited Ikisaya during the drought in October 2012 (see summarized list of coping strategies on page x). The coping strategies people employ differ according to their gender and level of deprivation. One of the most common coping strategies for men in Ikisaya is being a **casual laborer** for other people in the community. Casual labor involves doing small jobs in exchange of money or food. Many of these jobs are related to farming or livestock

keeping, such as herding goats or cattle, plowing land with bulls, setting up or repairing fences or digging terraces at the agricultural plot. This casual labor is informal in character; and is therefore not formally regulated by the government (Eriksen 2005). Few women engage in casual labor. According to my informants, the women that do perform such casual labor are normally single mothers who are the sole breadwinners of their family. Casual labor does not provide a stable income, and both the availability of work and the wage levels are influenced by supply and demand of labor. For example, many of my informants said that during drought, there are many people who want work. People are in great need of food and money, in addition to having much free time to work. At the same time, few people have money to pay casual laborers to work for them. There are therefore few jobs available, while there are many people who want the jobs. This drives the wage levels down, and the laborers receive less for their work.

Another coping strategy employed by my informants is doing petty **businesses** locally. Women in the community make tea, porridge or chapatti and sell to neighbors or at the market in Ikisaya, while men buy and sell livestock. Both men and women open small shops where they sell food items, such as sugar and rice, from their home or at the market. Some people do these activities year-round, but several of my informants said they only engaged in these kinds of businesses during the dry season when they were lacking food and income and do not have to work on their farms.

A third kind of coping strategy reported by my informants is **selling off livestock**. However, selling livestock reduces the resource base of a household, and is a short-term strategy. Several of my informants said they had been forced to sell some of their goats or cattle as a result of insufficient rainfall during the last rainy season, in order to get money to buy food or pay school fees for their children. A few of my informants said they had sold off so many livestock the last few years, that they now had none left. They were therefore worried that their next harvest would be poor as well, as they did not have any more goats or cattle to sell.

Making **handicrafts** for sale is another common coping strategy. Women primarily make baskets or ropes that they sell locally or at the market in Endau. The ropes are made from the bark of Baobab trees, and are used for several purposes, such as carrying jerry cans of water.

Many people in Ikisaya **borrow food or money** from family, friends, neighbors or the shops if they are in great need. Some also receive food or money for free from wealthier family

members or friends. Social networks are therefore quite important for food security during difficult periods. In households where the husband has migrated to urban areas for formal employment, **remittances** are important sources of money during drought and difficult periods. However, many of my female informants who had a husband working and living elsewhere told me that they very rarely, or never, got any help from their husbands. Their husbands visited Ikisaya maybe just once a year, and they got just a little money when he visited. Some were more fortunate, and got money sent to their cellphones (through the ‘M-Pesa’ service etc.²⁵) regularly. For these women, remittances from their husbands are of great importance when struggling to feed and educate their children.

In addition to this, people in Ikisaya also help each other during difficult times through various **group activities**, involvement in **community groups** and by organizing **fundraising ceremonies**. There are several farmers groups in the community, where the members help each other plough, plant, or dig terraces on their agricultural plots, as well as various pastoralist groups, where the members share knowledge about livestock keeping. One community group with many members is called “Itambia Ya Mbee”, a women’s group that produce soap for sale. NGO’s, such as the Catholic Diocese, also support some community groups through “food for work” programs. The members do various work in the community and are paid in food or money from the NGO’s. Fundraising ceremonies are organized occasionally in Ikisaya. These ceremonies are arranged by poor households in an effort to get money to send their children to school, bury deceased family members or pay hospital bills. These fundraisers are of great help to families in need, and is another example of the importance of social networks in Ikisaya.

Many people in Ikisaya get **emergency relief food** from the government or NGO’s, like the World Food Program and the Catholic Diocese, during droughts. According to my informants, the government distributed food to people in Ikisaya in March, July and October. The food is normally not given to everyone in the community, but distributed to the neediest. The amount of food distributed is also rather minimal. For example, in October, only people over 65 years were given food aid. About 60 people, almost only women, showed up to the sub-chiefs office, and were given 3kg of beans and ½ liter of cooking oil each. The government occasionally

²⁵ *M-Pesa* is a cellphone service provided by Safaricom in Kenya that allows for transferring money from one customer to another. When a person has been transferred money, that person can go to an agent and withdraw the money in cash (read more on www.safaricom.co.uk). Other mobile network operators have similar services that go by different names, such as Airtel which have Airtel Money (www.africa.airtel.com).

also distributes hybrid seeds to people in Ikisaya. My informants said they had not been given any seeds in 2012, but they had received some the year before.

Collecting honey for own consumption and sale has traditionally been a regular source of additional food and income in Ikisaya. Most people have at least one traditional beehive, which are made locally out of wood and placed high up in baobab trees. However, my informants reported that the amount of honey in their beehives have reduced drastically the last few years as a result of recurrent and prolonged droughts. Most of my informants had therefore harvested very little or no honey at all for the last few years. For example, one informant said; *“Before, I harvested from 10 beehives, a lot of honey. But because of drought the bees have gone away to look for water, so last time I harvested only a little bit from two beehives”*. A key informant also supported the claim that drought reduce honey production; *“When there is drought, the harvest is low. We may even end up without harvesting any, because the bees have nothing to eat, they have no water, they have nothing. No flowers. Nothing. But when there is enough rainfall, then there is a lot of honey.”* Further, one informant said use of pesticides had damaged honey production in the area. *“They are also being disturbed by this pesticide. Once you spray the crops, when they come, they suck the nectar, then they die. Because of the pesticide...It is poisonous to them”*. Honey production, once an important source of nutrition and income during difficult periods, is therefore no longer a secure coping strategy, and might be further negatively influenced by climate change and the increased use of pesticides.

Some few individuals in Ikisaya have their own motorbike, and some of these operate as motorcycle taxi, or ***boda-boda*** as it is called locally, for other people in the community during the dry season. The price of gasoline is high in Ikisaya, and fuelling a motorbike is expensive. The owners of motorbikes therefore need to charge quite high fees for transporting people. Using this *boda-boda* service is therefore restricted to the wealthiest people in the community. This coping strategy is limited to men, as only men owns and knows how to ride motorcycles in Ikisaya.

5.2.1.1 ‘Illegal’ Coping Strategies

In addition to these coping strategies, some people in Ikisaya engage in activities that are actually illegal in order to attain food or income. Most of these activities are done year-round, but they are intensified during difficult periods, such as during droughts. Many of my

informants referred to these activities as “survival mechanisms”, and argued that drought forced people in to doing illegal activities in order to survive.

Charcoal production is a common coping strategy that straddles the legal/illegal divide. Charcoal production and trade is regulated by law in Kenya (Gathui et al. 2011). Both commercial producers and transporters of charcoal need to apply for a license from the Kenyan Forest Service (KFS) and pay a license fee in order to obtain permission to produce and transport charcoal legally. Landowners that only produce charcoal for use in their own household do not need a permit. Commercial producers of charcoal must however form Charcoal Producers Associations (CPAs), whereby the members are required to follow guidelines on reforestation and conservation to ensure sustainable production of charcoal. It is for example illegal to use endangered tree species to produce charcoal (Gathui et al. 2011). Thus, producing and selling charcoal without a permit is prohibited, and may be punished with heavy fines or imprisonment.

The Syou Charcoal Burning Association was established in Ikisaya in 2011 and became effective in 2012. According to the sub-chief in Ikisaya, this association has about 60 charcoal producing members. Most of my informants who produce charcoal for sale said they are members of this association, but a few said they were not, and are thus producing illegally. Those who said they were not members seemed somewhat unaware of the current laws and regulations on charcoal production, and most of them said they thought all kind of production of charcoal is illegal. I also asked them if they knew if the trucks coming to collect the charcoal had licenses. Some were not aware that transporters are required to have permits, while others said they did not know if they had a permit or not; they had never asked them.

There might be a number of reasons why some people in Ikisaya produce charcoal without a permit. One reason might be lack of information from the government about the rules regulating charcoal burning, making people unaware that they are indeed allowed to produce charcoal if they join and abide by the regulations of the CPA. I did not investigate this issue further, but regardless of the reasons behind choosing to produce charcoal illegally, this kind of coping strategy is very risky. If a person is caught burning charcoal without a permit, that person might be punished with a heavy fine or imprisonment.

The charcoal produced in Ikisaya is however generally not used by people locally. Most of the inhabitants in Ikisaya do not use charcoal for cooking; they use firewood. Out of my 50

informants, only three said they used charcoal for cooking in their household, and they all said they used charcoal only in the rainy season when it was more difficult to find dry firewood. The informants that used firewood said it was expensive to buy the *jiko*, a special cooker for charcoal, and buying charcoal was more expensive than firewood. Most of them could therefore not afford using charcoal, and they rather collected dead firewood for free on their own land. Most of the charcoal that is produced in Ikisaya is collected by trucks from Nairobi and other cities, and sold in urban areas. About 82 per cent of the urban population use charcoal for cooking in Kenya (Gathui et al. 2011), and rapid urbanization and population growth thus drives the demand for charcoal from the rural areas of Kenya, such as Ikisaya.

Another ‘illegal’ coping mechanism is **hunting wild game**, primarily Dik-dik’s (a very small antelope, called *Kavii* in Kikamba) and bigger antelopes. The sub-chief of Ikisaya told me that it has been illegal to hunt wild game in the area for several decades, and that it is also illegal to sell wild game meat in restaurants. The Kenya Wildlife Service officials patrol the area regularly, and arrests people who are caught hunting or selling wild game meat.

One whole Dik-dik is normally sold locally for 200 Ksh²⁶, while an antelope is sold for 1500 Ksh²⁷. Hunting antelopes are therefore more profitable, but they are more difficult to find. Hunting is only done by men, and it is primarily done in the dry season as the bush gets thick and practically impassable during the rainy season.

Two methods of hunting wild game are used in the area; using bow and arrow, and using wires. The Dik-dik’s are very small, approximately the size of a dog, they jump around in the bush, and they are very difficult to hit with an arrow. Wires are therefore preferred to use for hunting Dik-dik’s, while arrows are sometimes used to kill bigger antelopes.

The wires are hung between trees, and the animals are caught as they run into them. If the hunter is close by



Photo 3: Dik-Dik caught by hunter in Ikisaya
(Photo by Lan Marie Nguyen Berg, 2012).

²⁶ 200 KSh = 3 USD (Exchange rate: 0.0151, per 07.05.13).

²⁷ 1500 KSh = 22 USD (same as above).

when the animal is caught by the wires, he kills the animal with a big knife (a *panga*) instantly. However, waiting for an animal to run into the wire is time-consuming, and the hunters normally hang up several wires in the bush and returns to them at a later point. Using wires is a convenient way of hunting, as well as it is regarded to be safer in terms of being discovered by the KWS officials. It is considered to be more difficult to be caught when hunting with wires than when hunting with bow and arrow.

However, using wires is an indiscriminative way of hunting, and untargeted species are frequently caught by the wires. Goats are regularly killed by the wires, as well as monkeys and other animals. Many of my informants said they had lost goats as a result of hunters using wires. If people catch goats in their wire by mistake, they are supposed to tell the owner and compensate him. Goats are normally marked with the initials of the owner, so the hunter will know who the goat belongs to when it is caught in the wire. Telling the owner is however rarely done, and the hunters frequently keep the goat and eat it in secret as they do not want to pay compensation, or do not want to admit that they are hunting because it is illegal. One key informant said that sometimes people also take advantage of this problem; they steal goats and pretend it was caught by hunters.

Further, some hunters enter Endau Hilltop forest to hunt bigger antelopes that are not as abundant down on the plateau as in the hills. As mentioned before, the hilltop forest is government land and it is strictly prohibited to do hunting in the forest. One hunter in Ikisaya told me that he sometimes hunted in the government owned forest, but he dreaded doing so because of big snakes and leopards. He said there are some very big and dangerous snakes up in the hills, and if he were to be bitten, it would be difficult to reach the hospital in time.

Several of my informants said that people are hunting more wild animals now compared to previously, and that the number of animals has therefore been reduced. One key informant said that *“they are reducing in number. Before there were very many, you could even see them around here, but now there are fewer.”* I asked him why they are reducing, and he answered; *“Because many people here have to hunt to get an income, they have no choice. So when so many people go hunting, the number of animals is reduced. There is big pressure on the wildlife here.”*

I asked some hunters I talked to why they do hunting when they know it is illegal. All of them said they did not have any other way of getting enough income for themselves and their

family, and therefore felt they had no other choice. One hunter said; “*Well.. If I had another means of getting enough income, I would not do hunting. It is very hard, very tiring, and it is very risky. There are also many snakes in the bush, so it is dangerous.*”



Photo 4: Fruit from Mwatini tree, used to make Kaluvu.

A third ‘illegal coping strategy’ used by some people in Ikisaya is **brewing Kaluvu**, a local beer. Kaluvu is made of water, honey or sugar, and a fruit from the Mwatini tree²⁸. One jerry can containing 20 liters of Kaluvu is normally sold for 400 Ksh in Ikisaya. Kaluvu is an integral part of many community functions in Ikisaya, such as weddings and burial ceremonies.

The beer is also often used as payment to casual laborers, or a token of appreciation for help. For example, when a person has deceased, young and strong men are normally “hired” to dig the grave. They dig during the night, because it is not so hot, and they are given Kaluvu and goat meat as payment for their labor.

However, my informants said that brewing Kaluvu is illegal in Kenya, because it is difficult to regulate the production and sale of local brews, and because the government does not receive any revenues from the sale. One key informant said;

Yes, it is illegal, because... for one, there are no revenues given to the government, no taxes. Two, most of the takers, the drinkers, are irresponsible. If they have 500 Kenyan shilling, they go buy Kaluvu, they already consume the 500 shillings, it becomes two, three, four, they get so irresponsible, give give give to other people, and after that, they have spent all their money. Most of them are irresponsible. Most of them are not active, they can't go to the shamba, can't do anything. Women say their roles are not catered for, their rights are ignored, the husband come home in the evening and just sleeps, he just sleeps and don't conduct their rights to be fulfilled. So the government has said that Kaluvu is illegal. Let people go to the bar, take one beer for 130 shillings then they won't take ten, because then they will already have parted with 1300 shillings. They will take just one and rush home.

²⁸ The Mwatini tree is called Sausage tree in English. The botanical name is *Kigelia Africana*.

There is only one bar in Ikisaya that has a permit to sell alcohol. This bar must pay a yearly fee to the government to keep the permit. This bar is not allowed to sell Kaluvu. Kaluvu is therefore sold on the black market in Ikisaya. According to a key informant, a person that is caught brewing Kaluvu is arrested and forced to pay a fine of 50,000 Ksh. My informants said that very few people have been arrested for brewing Kaluvu in Ikisaya, because it is somewhat overlooked by the police. It was indicated to me during my fieldwork that police officers are given a bribe, Kaluvu for free or some money, to keep them from arresting those who are brewing. A female Kaluvu-producer said in an interview; *“Some of the officers come here and take something from me. And others, they just come here to drink... Some of them want money, some want the brew I make.”*

Almost only men drink Kaluvu, as it is considered somewhat inappropriate for women to drink alcohol. However, brewing Kaluvu is done almost exclusively by women. I asked my informants why it is only women who brew Kaluvu. One female informant said; *“If a man produces it, they will drink it all themselves, or give it to someone for free. They will not make any money. But women sell it to have money to feed their children and pay school fees”*. Another female key informant said;

It is only women who do it. If men do it, maybe they will not sell any of it, they will drink it all. And then they will have no money to buy more sugar, or honey, to make it. So, in most cases, it is the women who sell it. It is not common to find women who drink it, it is rare. Women rarely drink. Another reason, is that many men have grown to be very irresponsible, and are not concerned about whatever is going on in their home. So, the woman is there with the children, the children want to eat, the woman does not have any other source of income, so automatically she has to look for a way out, at least to let her children eat. Because the husband spends the whole day loitering around, drinking whatever he finds, eating whatever he gets, while the woman is at home, the children are crying. So many times, women have taken the responsibility of doing what they can do, at least to help their children, because their husbands have proven to be quite irresponsible and does not care much.

Further, many of the women who brew Kaluvu are single mothers who are the sole breadwinners of their family. A single mother producing Kaluvu said; *“That Kaluvu is my husband, because I don’t have a husband to assist me. I have children who need food and school fees. So, the Kaluvu is my husband. The Kaluvu supports me”*. Many of the brewers are also old women, normally widows, who are no longer able to do agriculture. These are referred to as ‘the old mamas’. For example, a 70-year-old key informant said; *“I can’t do*

farming, I can't cultivate, I am old and not able to work on the shamba. I can only brew that beer".

My informants argued that those who brew Kaluvu, brew more during droughts, because they need money to buy food and pay school fees. According to my informants, there is also higher demand for Kaluvu during droughts, because men drink more during difficult periods and when there is not much else to do. A male key informant said that men drink more during droughts because; *"People want to feel better, forget about the hardship they and their family struggle with. Escape from their problems"*.

Again I asked my informants why they brew Kaluvu when they know it is illegal. They said they had no choice. If their harvest failed, brewing Kaluvu provided them with income they could spend on food and school fees. One informant said; *"I would be happy if I can get another opportunity of getting money. Brewing Kaluvu has become a burden for me, I am in fear of getting caught. But I am tired of borrowing money from people to buy salt, soap, sugar. So I have to do it"*.

Theft of livestock, money, food or Kaluvu happens sporadically in Ikisaya. Several of my informants told me that they had experienced theft. Most of them reported that some of their livestock had been stolen. They said theft of cattle or goats usually occurs during the dry season when their livestock are grazing unsupervised; *"Many people leave their flocks alone, so people take advantage of taking them when they are alone in the bush"*. Yet, as mentioned previously, goats are frequently caught by wires used by hunters to catch wild game, and the hunter seldom reports this to the owner of the goat. Many of the goats that go missing might therefore have been caught by wires, instead of having been stolen intentionally. It is thus difficult to know how many of the lost goats have actually been stolen.

Stealing is an offence in Kenya, and a person caught stealing is fined or sent to prison. Corporal punishment for stealing is however also fairly common in Ikisaya; a person caught stealing is frequently beaten up heavily by other men in the community instead of being reported to the police. A male informant said that if a person steals, and *"the locals see him; he is hunted down"*. This custom is supposed to deter people from stealing. I read about such an incidence in a newspaper from Kitui in October 2012; some men that had been caught stealing livestock had been lynched by an angry mob in another area of Kitui. Stealing is

therefore very risky; a person caught stealing faces either corporal punishment, being fined or sentenced to prison.

My informants said that theft mainly occurs during droughts, when people are lacking food or money. One informant said that people steal during “... *the times of drought. Because now you find that somebody don't want to work, don't want to do casual work, but he wants to eat and drink. And his family too. So, the only way out is to go out and steal*”. Another informant also said that “*When people face food shortages, they opt to stealing*”.

A final, arguable fairly common, illegal coping strategy in Ikisaya is **prostitution**. This is referred to locally as “young girls having boyfriends”. According to my informants, such kinds of arrangements are widespread in the area. The girls are given food or money in exchange for sex. The men who buy these services are called “boyfriends”. My informants said that the boyfriends are normally older, married, rich men, while the girls are often very young and come from poor families. They either buy sex from the girls sporadically, or they develop longer-term “relationships”, where the man pays them on a regular basis for sexual services. I discussed this issue with some women in a focus group discussion. One woman said;

The young girl can come from home, without any money, and she can see others eating...she might desire to eat as well. So someone might come, and suggest to give her 10 Ksh to buy chapatti, and you know, a man cannot give something freely. So when he gives, you must follow up.

Another woman then said that “...*money is the problem. Because men can cheat people with money, and when the man tells the girl “I will give you this amount”, the girl can accept. And the girl can be very young. And the problem is that in the process, you can get pregnant*”.

My informants said that the young girls, who sell sex sporadically, do it mostly during the dry season or during droughts when they lack food and money. One informant said; “*It happens when it is dry, in the dry season. It is mostly then. That is when the young girls sell themselves to get money to buy food*”. Another informant said that prostitution is a result of poverty. “*If it was not for poverty, these people wouldn't do that. They are not immoral*”.

According to my informants, this “boyfriend arrangement” frequently leads to teenage pregnancies. When a young girl gets pregnant outside of marriage, she is usually left to take care of the child by herself. The man who got her pregnant seldom admits to be the father of

the baby, and normally refuses to support her in bringing up the child. A key informant said that when young girls get pregnant “*They just suffer with their children. Unless she has a responsible boyfriend who marries her and supports her. Unless they are married, it is not easy to find men who assist young ladies in caring for their children*”. The young girls selling sexual services also risk being infected by HIV/Aids and other Sexually Transmitted Diseases. A young, female informant explained that; “*you can be convinced by somebody, then you say yes, but that person might then refuse to use a condom. And when you are finished, you get affected. You get sick*”.

Common Coping Strategies in Ikisaya

Legal activities

- ❖ Doing **casual labor** for others in the community
- ❖ Doing various kinds of **business**, such as selling tea, porridge or snacks locally
- ❖ **Sell livestock**
- ❖ Make **handicrafts** for sale, such as producing ropes, baskets, or knives
- ❖ **Receive money or food** from family, friends or neighbors
- ❖ **Borrow money or food** from family, friends, neighbors or shops
- ❖ **Remittances** from family members working elsewhere
- ❖ Engage in various **group activities** and **community organizations**
- ❖ Organize **fundraising ceremonies**
- ❖ **Receive food or seeds** from the government or aid organizations
- ❖ Collect **honey** for own consumption or sale
- ❖ Use own motorcycle as a **boda-boda** (motorcycle taxi)
- ❖ Produce **charcoal** for sale, with permit

Illegal activities

- ❖ Produce **charcoal**, without permit
- ❖ **Hunting** wild game
- ❖ Brew **Kaluvu** (a local beer) for sale
- ❖ **Stealing**
- ❖ **Prostitution**

Table 5: Summary of common drought coping strategies in Ikisaya.

5.2.2 Adaptive measures

Investigating how people in Ikisaya are adapting to climate variability and change in the longer-term sense was fairly challenging. When I asked people if they have started doing anything to adapt to changes in the climate, most of them said they did nothing differently than normal, or said that there is nothing they can do besides hoping for sufficient rain every season. However, a few did identify some adaptation measures they have instigated; digging terraces on their agricultural plot; planting hybrid seeds; changing the type of crops to plant and storing rainwater. The adaptation measures employed thus seem to be primarily aimed at adapting to lower rainfall amounts.

Many of my informants said they have recently started **digging terraces** on their farm because of a reduced amount of rainfall. The purpose of the terraces is to retain rainwater, reduce run-off and prevent soil erosion, in order to enhance crop yield when there is little rain.

A male informant said; *“Because our rain is very little, we do terracing to have that collection of water, not to run to the rivers, but to stay there. So it collects, it stays at that place, and the plants grow. Soil erosion takes place if you do not have terraces on your shamba”*.

The terraces are dug manually, and it is therefore a labor-intensive and time consuming process. Once the terraces are dug, they also need to be maintained and might have to be repaired from time to time. One informant said that hiring casual laborers to dig terraces is quite expensive; it normally costs 300 KSh²⁹ for each 3 meters of terracing. Some of my informants said they would like to have terraces on their shamba, but that they could not afford to pay casual laborers to dig them. They were themselves elderly or sick, and could not dig them



Photo 5: Terrace on a farm in Ikisaya (Photo by Marianne Mosberg, 2012).

²⁹ 300 KSh = 4,53 USD (Exchange rate: 0.0151, per 07.05.13).

themselves. Elderly, sick or disabled people who do not have money to pay casual laborers to dig or mend terraces, therefore generally do not have access to this adaptation measure.

Another adaptation measure identified by my informants is planting drought resistant **hybrid seeds**. My informants said that the government some years ago advised them to start planting hybrid seeds that require less rain than normal seeds do, and that they have been given some hybrid seeds sporadically by the government and NGO's for the last few years. When they are not given the hybrid seeds for free, they have to buy the seeds in Endau or Kitui town. The seeds are very expensive. Hybrid seeds costs about 250 KSh³⁰ per kg, while local seeds costs about 30 KSh³¹ per kg. Further, the hybrid seeds cannot be replanted and new seeds must therefore be bought every season (key informant). Very few people in the community can afford to buy hybrid seeds when they are not given them for free. A single mother said during an interview; *"I plant hybrid seeds if the government give us hybrid seeds. If I do not get them, I plant local seeds"*. Only 10 of my 50 informants said they have ever bought hybrid seeds. These 10 were mainly shopkeepers or had formal employment with a salary, and they all had a relatively high level of education. Based on observations, formal interviews and informal discussions conducted during my fieldwork, it seem to me that those who can afford to invest in hybrid seeds in Ikisaya are those who have a steady income or come from a relatively wealthy family.

Those of my informants who have planted hybrid seeds said they harvested at least twice or thrice as much from the hybrid seeds as compared to the local seeds when there was little rain. If there was plenty of rain, the local seeds did well. Most of them therefore said they planted both; they invested in buying some hybrid seeds in case of little rain, and planted the rest of the field with local seeds in case of sufficient rain. Planting a mix of hybrid and local seeds seem to be an appropriate way of securing a harvest in the face of great climate variability, but this adaptation strategy is currently not accessible by all members of the community; the poorest rely on the sporadic distribution of free seeds by the government or NGO's.

Three of my informants said they have changed the crops they plant as a result of changing weather patterns. They said the local maize usually fail when there is little rain, and that they have started planting less maize and rather plant more millet, cowpeas and greengrams. For example, one of these informants said; *"Before we were used to planting maize and we*

³⁰ 250 KSh = 3,78 USD (same as above).

³¹ 30 KSh = 0,45 USD (same as above).

harvested a lot, now we plant maize and it fails... now I have started planting millet because it needs little rain". This corresponds to findings from my semi-structured interviews with 50 respondents; only 6 reported that they harvested some maize after the last rainy season in March-May. The rest said all the maize failed due to a poor rainy season. The other crops seemed to do better with marginal rain; 19 said they harvested some greengrams; 12 harvested sorghum; 12 harvested millet, and 7 said they harvested some cowpeas.

Another strategy employed by people in Ikisaya to adapt to low amounts of rainfall, is **storing rainwater**. Buckets, trays, jerry cans, barrels or large tanks are used to collect water flowing from the iron sheet roofs during the rainy season. Most people use the small jerry cans of 20 liters or barrels of about 100-200 liters, while some very few households have bought and installed large water tanks, which hold about 10,000 liters, on their compounds. Those that have bought the large water tanks are relatively wealthy household. According to an informant in Ikisaya, water tanks holding 10,000 liters costs between 90.000 and 100.000 KSh³².



Photo 6: Rainwater tank of 10,000 liters, in Ikisaya (Photo by Marianne Mosberg, 2012).

I talked to one of the households who owned a water tank when I visited Ikisaya in October 2012. They still had water left in their tank from the rain that fell in March-May, because they had rationed the water to avoid emptying the tank before the end of the dry season. The mother in the family said this tank was very helpful to her, as she did not have to spend hours on fetching water throughout the dry season, and could rather spend her time doing productive work. Installing large water tanks would therefore be very useful for people in Ikisaya, as it would provide them with access to water during the dry season, it would reduce women's workload, and provide women with more free time they could spend on doing income-generating activities. However, the tanks are very expensive. This adaptive measure is accordingly not available to most people in Ikisaya.

³² 90.000 – 100.000 KSh = 1.359 -1.510 USD (Exchange rate: 0.0151, per 07.05.13).

5.3 Discussion and summary: the vulnerability context in Ikisaya

This chapter has outlined the key climatic and societal drivers of vulnerability in Ikisaya, and presented common strategies employed by people to respond to these. The vulnerability drivers are interlinked. Climatic factors contribute to water scarcity, income poverty, food insecurity and malnutrition. Economic, political and socio-cultural factors in turn exacerbate the adverse effects of climatic variability and change. Furthermore, the combined effects of climatic and societal drivers of vulnerability, and how people respond to these, contribute to differential individual vulnerability in Ikisaya.

Rain is vital for people in Ikisaya, as the majority of the people in Ikisaya are poor farmers who rely on rain-fed agriculture. When the rain fails; their harvest fails, and they are left with no food, no money, and no seeds for planting next season. The total amount, as well as the timing, of rainfall is therefore of crucial importance for the well-being of people in the community. However, rainfall is not only generally low in the area, but it is highly inconsistent and unreliable. The rainy seasons frequently fail, leading to recurrent droughts. Failing rainy seasons also contribute to water scarcity, which force women to walk further from their house to fetch water. This reduces the time they have available for doing income-generating activities.

The people in Ikisaya assert that the climatic situations is getting increasingly worse; the total amount of rain has reduced the last two or three decades, the timing of the two rainy seasons have become even more erratic and unreliable, and they experience more frequent droughts. They also feel that temperatures have increased. My informants therefore stated that it is becoming ever more difficult to be a farmer in Ikisaya, and some said they were worried that the situation will exacerbate in the future, and thus make it impossible for people to stay in the area. It is however highly uncertain exactly how global warming might change the climate in Ikisaya, but it is possible that both temperatures and the rainfall pattern will undergo changes.

Not only climate factors challenge the well-being of people in Ikisaya. Income poverty and unemployment is widespread in the area. Poor infrastructure and lack of cheap, frequent and convenient transportation options reduce mobility, and reduce access to basic health services. Restricted access to resources in the Endau Hilltop forest reduces the possibility of livelihood diversification for people in the area. Ongoing tensions between settled Kamba agro-

pastoralists and Kenyan Somali pastoralists lead to insecurity in Ikisaya, and inhibit seasonal movement of livestock.

People in Ikisaya however employ a variety of strategies to cope with climatic and societal drivers of vulnerability (see table on page x). These activities provide people with food and money during difficult periods, but they are highly unstable and unreliable. Some people are also engaging in illegal activities. These illegal activities are risky; if caught, they might be fined or sent to prison. People who are caught stealing might also be subjected to corporal punishment, and women who sell sex risk being infected by sexually transmitted diseases such as HIV/Aids and getting pregnant. Climatic and societal drivers seem to ‘push’ people into illegal activities.

When it comes to adapting to changes in the longer term, some of my informants said they have started digging terraces on their agricultural plot to retain the little rain that comes, some have changed the type of crops they plant, some have started planting hybrid seeds, and some very few individuals have bought large water tanks to store rainwater. The adaptation measures of planting hybrid seeds and buying large water tanks have very high investment costs, and are therefore currently not available to most people in Ikisaya. The digging of terraces requires either a high investment, or a high input of labor. This is therefore neither available to everyone in the area.

As explained in the theoretical framework chapter, the concept of ‘Adaptive capacity’ is defined as the ability of an individual, household or community to adapt to changes, moderate potential damages or to take advantage of the opportunities caused by changes (Burton et al. 2002). The adaptive capacity of individuals and households in Ikisaya is determined by their ability to adjust to stressors and changes they are facing, such as climate variability and change. Although people in Ikisaya have developed various strategies to cope with droughts and challenges they currently experience, this might not be sufficient to maintain wellbeing in the longer term. The coping strategies they currently employ are not necessarily sustainable, and might not enable them to cope with challenges over time. Most of the coping strategies employed are mere ‘survival strategies’ that provide people with food or money right now, but they do not secure wellbeing in the future and do not reduce vulnerability.

In general there seemed to be an emphasis on short-term coping rather than longer-term planning in Ikisaya. Most people displayed a feeling of ‘helplessness’, stating that they just

have to cope with the challenges they are facing, there is nothing else to do. People focus on problems they are facing today, not so much on preparing how to tackle problems that might arise in the future. It is not difficult to understand why they are worried about making ends meet on a day-to-day basis. They struggle with putting food on the table every day, send their children to school, and get enough water for themselves and their family. This is difficult enough for most people. Preparing for further challenges in the future is therefore not necessarily a priority, or even an option. However, the capacity to cope with current problems does indicate that people have developed good strategies to survive during difficult periods. I did not hear about anyone dying as a result of hunger in Ikisaya, in spite of recurrent droughts and widespread poverty. Therefore it seems like people in Ikisaya have a high coping capacity, but perhaps not as high adaptive capacity.

Further, it might be argued that religion acts as a barrier to adaptation in Ikisaya. Several of my informants said they meant that the weather is controlled by God, and therefore changes in the climate are caused by God. For example, a female informant said *“God brings too little rain”*. Some of the people I talked to in Ikisaya thought the weather pattern in the area has changed because God is punishing people for sinning. For example, one informant said *“I don’t know if people are doing opposite of God, or what is wrong, but 20 years ago it was very good here, but now there is drought and drought.”* Failing rain is accordingly by some understood as God’s punishment of immorality.

This belief influence how people respond to changes in weather patterns. Many people seemed to believe that it is impossible to plan for the future, because it is just up to God to bring enough rain. Therefore they do not adapt to changes in the climate. I asked one informant if she had started doing anything differently because of the changing rainfall pattern. She said; *“I have not changed anything, I just pray to God that he will bring rain, I don’t do anything else”*. Another informant said; *“if it doesn’t rain, God will show us what to do”*. The pervasive belief that God controls the weather, and will help people cope with challenges, might therefore inhibit adaptation in Ikisaya. People might refrain from adapting to a changing climate because they think that as long as they refrain from sinning, climatic conditions will improve.

Furthermore, the character of vulnerability in Ikisaya illustrate that poverty is not necessarily synonymous with vulnerability. As explained in chapter 3, the theoretical framework, the processes that contribute to poverty are not necessarily the same as those contributing to

vulnerability (Eriksen et al. 2007; Tol et al. 2004). In Ikisaya, the factors that contribute to multidimensional poverty, characterized by multiple deprivations, include pervasive income scarcity, high unemployment levels and lack of public services such as health care and higher education. Processes that contribute to vulnerability are however not limited to these factors, but also involve factors such as socio-cultural inequity and power imbalances. Poverty is thus tightly linked with vulnerability in Ikisaya, and can in various ways contribute to an inability to cope with stressors such as climate variability and change, but not only poverty contribute to vulnerability, and not only those who are poor are vulnerable.

Chapter 6: Ikisaya solar energy centre and sustainable adaptation

The previous chapter described the character of contextual vulnerability in Ikisaya, and examined the role climatic and societal factors and responses to these, play in shaping the vulnerability context. This chapter investigates if Ikisaya solar Energy Centre and the services provided by the centre can contribute to sustainable adaptation to climate variability and change in Ikisaya.

As mentioned in chapter 2 (the theoretical framework), adaptation to climate change refers to adjustments aimed at moderating and accommodating the impacts of climate variability and change. However, adaptation interventions to reduce the vulnerability of some social groups may at the same times increase the vulnerability of others. For those affected negatively, such measures would thus result in maladaptation. The concept of ‘sustainable adaptation’ recognizes the risk of maladaptation, and maintains that adaptation should be socially and environmentally sustainable. Sustainable adaptation is defined as “adaptation that contributes to socially and environmentally sustainable development pathways, including both social justice and environmental integrity” (Eriksen et al. 2011: 8). O'Brien and Leichenko (2007) argue that sustainable adaptation to climate change entails reducing vulnerability and promoting long-term resilience in view of social justice and environmental integrity. Reducing vulnerability by addressing contextual conditions and drivers of vulnerability is therefore important for sustainable adaptation, and is the focus of analysis in this chapter.

This chapter investigates how the activities of the Ikisaya Solar Energy Centre fit with the four principles of sustainable adaptation, which involves; recognizing the context for vulnerability, acknowledging that different values and interests affect adaptation outcomes, integrating local knowledge into adaptation responses and considering potential feedbacks between local and global processes (Eriksen et al. 2011). The primary focus of this chapter will be on the first principle, namely the implications of the Energy Centre on the vulnerability context. However, the four principles are interrelated and findings about the vulnerability context also have implications for the other three principles. The first part of this chapter will investigate if the Energy Centre and its services ease or exacerbate the adverse effects of the drivers of vulnerability identified in the previous chapter. As not all people are

equally vulnerable in Ikisaya, this chapter will also discuss how the Energy Centre influences differential vulnerability across different social groups.

The second part of this chapter will investigate how contextual conditions and multiple stressors in turn influence the viability of the Energy Centre. The premise for this is that the Energy Centre not only influences the vulnerability context in Ikisaya; the vulnerability context also influences the Energy Centre. For example, drought might make people unable to use the services at the Energy Centre, which in turn may lead to economic losses for the centre and thus challenge the very existence of the centre. There is therefore a reciprocal relationship between the solar Energy Centre and contextual vulnerability, a relationship that is important for sustainable adaptation.

This chapter will in this way address the second sub-question of this thesis;

ii) *How does the solar Energy Centre influence the vulnerability context in Ikisaya, and how do climatic and societal factors in turn affect the viability of the solar Energy Centre?*

The third and final part of this chapter will then summarize and answer the main research question of this thesis: *Can local supply of solar energy contribute to sustainable adaptation to climate variability and change in rural Ikisaya, Kenya?*

6.1 Impact of Ikisaya Energy Centre on the vulnerability context

The first principle of sustainable adaptation involves recognizing and, where possible, addressing directly contextual vulnerability, including multiple stressors (Eriksen et al. 2011). The previous chapter has outlined the main climatic and societal drivers of vulnerability in Ikisaya. This section will address how the Energy Centre and its services contribute to reducing (or potentially increasing) how vulnerable members of the community are to such biophysical climatic conditions. The previous chapter discussed how climatic and societal drivers of vulnerability, and people's responses to these, contribute to *differential* vulnerability in Ikisaya. This section will therefore first investigate the accessibility to the Energy Centre, to outline how the benefits from the centre are distributed in the community and how differential vulnerability is influenced.

6.1.1 Accessibility

Analysis indicates that use of Energy Centre services is highly socially differentiated and also linked to livelihoods and coping strategies of a household. Findings from fieldwork indicate that services offered by the Energy Centre in Ikisaya are unaffordable to many community members. The figure below show the number of informants who said they had and had not used a selection of the services at the Energy Centre:

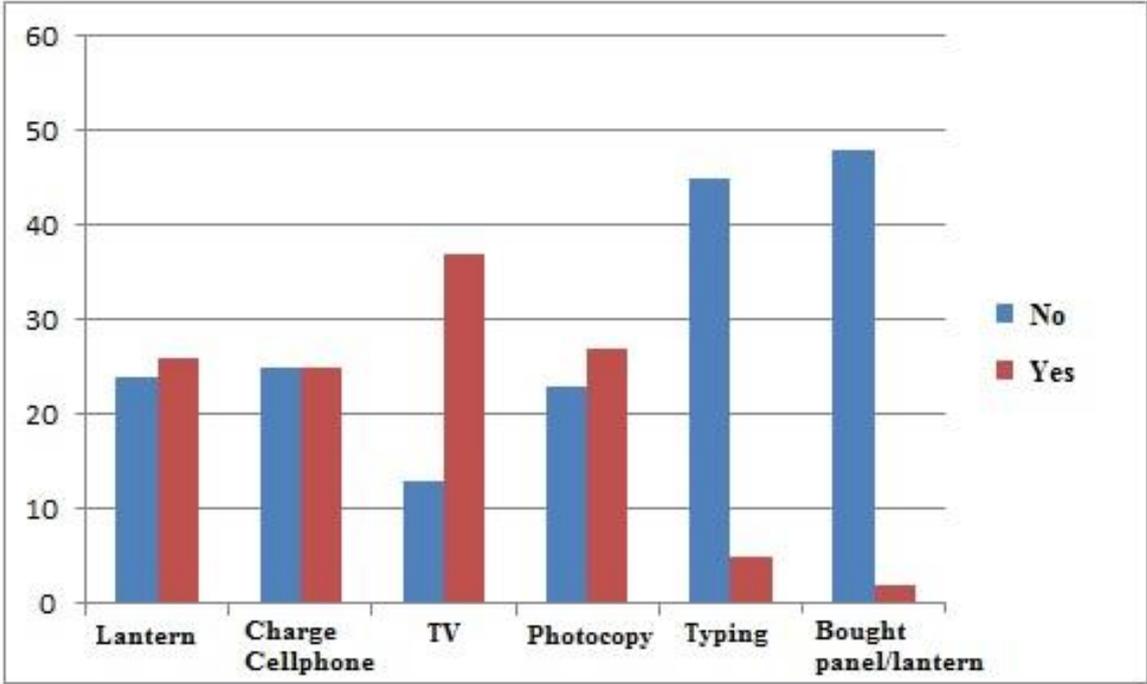


Figure 11: My informants’ use of services offered by Ikisaya Energy Centre (n=50).

The portable lanterns, cellphone charging, TV and the Photocopy services were the most popular services offered by Ikisaya Energy Centre among the informants. At least half of my informants had used these services. It is important to emphasize that this graph shows the number of people who said they had used the different services at least *once*, not if they used them *regularly*. Many of them said they could not afford to use them regularly; they used them only occasionally, when they had enough money.

Those of my informants who said they had not used the services at the centre said they could not afford to use them because the prices were too high. Most of these had only farming, casual labor or remittances as their main source of income. Those who did use the various services generally had multiple sources of income, for example; farming and livestock keeping, farming and formal employment, or farming and a business/shop/restaurant. For

example, a bigger percentage of those who have multiple sources of income said they had rented a lantern at Ikisaya Energy Centre compared to those who had a single source of income;

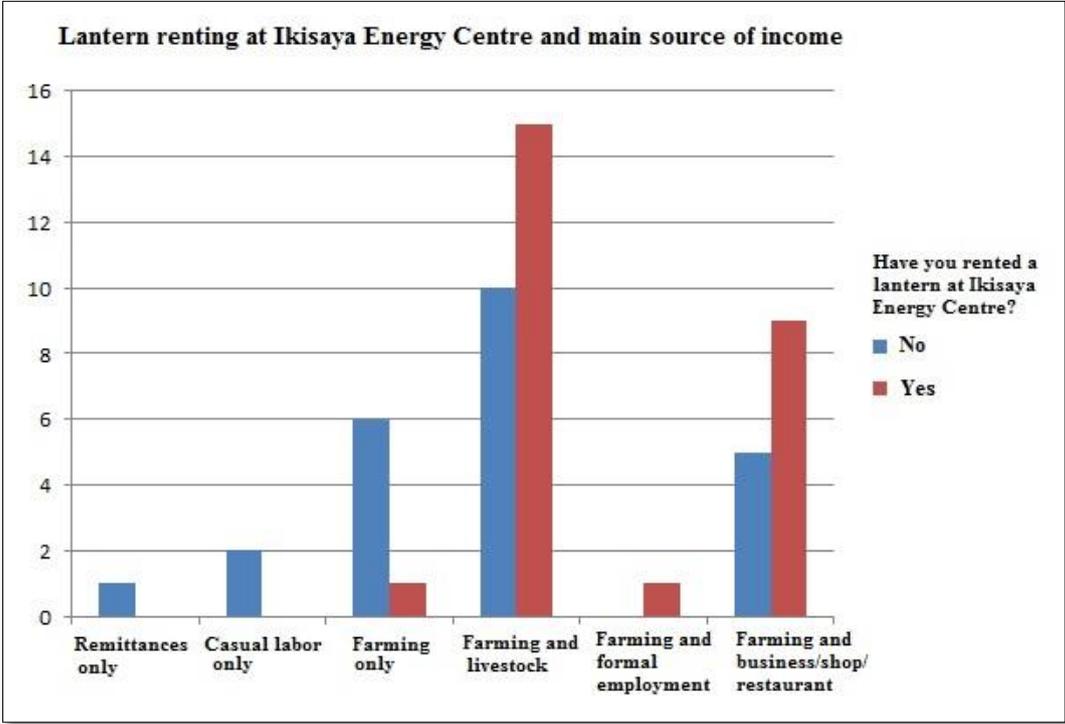


Figure 12: Number of informants who said they had and had not rented a lantern at Ikisaya Energy Centre according to main sources of income (n=50).

A similar pattern emerged with regard to TV viewing and cellphone charging at the centre. However, it is important to emphasize that I did not interview the same number of people within each of the various ‘sources of income’-groups, and these figures might not represent the issue of accessibility accurately. The interview data also suggest that the use of the centre were higher among those who have multiple sources of income; those who keep livestock, have formal employment, do business or own a shop or restaurant in addition to doing farming, compared to those who relies only on agriculture, casual labor or remittances. Those having formal employment, doing business or owning a shop/restaurant were also identified by my informants as the wealthiest individuals in the community.

This is confirmed by one interviewee from the Energy Centre, who said that the people who came to use the services at the centre during the drought in September/October 2012 were “those who are well in their lives, like the local teachers and those who are employed”. It

thus appears that those who are able to use the services at the Energy Centre regularly are those who have a stable income. Poorer groups are only able to use the services occasionally.

Ikisaya Energy Centre has a retail shop selling items such as solar panels and lanterns. These can be paid for upfront, or in installments. Only two of my informants had bought small Solar Home Systems (SHS) with a panel that supports light and cellphone charging (these are also called Powapacks). These cost 6800 KSh³³ at the centre. One of these had paid for the SHS upfront, the other one paid in installments. They said they wanted to invest in buying their own solar panel, because they would save money they would otherwise spend on kerosene and charging their cellphone. They would also save time as they did not have to come to the Energy Centre regularly to charge a lantern or cellphone. Buying an SHS upfront is a big investment, unaffordable to most people. However, they are profitable in the long term; there are no more expenses on light or cellphone charging after the investment is made. The option to pay in installments is very helpful to those who do not have the ability to pay upfront. This allows people to make an investment that over time will save them time and money.

In addition to low purchasing power, lack of infrastructure and limited transportation options restrict access to the services offered at the Energy Centre. Those living far from the Energy Centre have to walk long distances to reach the centre. For example, a female informant who lived 5 km from the Energy Centre said she did not use the lantern because; *“It is too far from my place. I can’t make it all the time to return it there”*. However, some of my female informants said they combined fetching water with using the services at the Energy Centre. They brought their lanterns and cellphones when they went to Ikisaya to fetch water in the morning, and they often had to wait for many hours to get water anyway. Some also said they could pass some of the long time they had to wait for water by watching TV at the centre. Some of those who did not go to the market to fetch water sent their lanterns with their children going to the primary school near the centre. The agents that were established in Kalwa, Endau and Malalani have also made it easier for those living far from Ikisaya Energy Centre to access the lanterns. Still, some of my informants complained about the distance to the centre and the agents, and said the distance restricted them from using the services.

I asked my informants who they thought in general *benefited* the most and the least from the Energy Centre in Ikisaya. Most of them said those who benefited the *most* were the members of the CBO (the Community Based Organization that is running the Energy Centre), those

³³ 6800 KSh = 102 USD (Exchange rate: 0.0151, per 07.05.13).

who could afford to use the services, the staff at the centre and school children. Those who benefited the *least* were those who were not members of the CBO (non-members), those who could not afford to use the services (non-users), those who lived far from the Energy Centre and agents, and those who, for various reasons, did not *want* to use the services. For example, a poor, male farmer said he was not using the services, and said that people like himself, who did not have money, did not benefit. Some argued that everyone in the community has benefitted equally. For example, a male informant said; *“Everybody has benefitted. You cannot say so and so has benefitted more than the other. The most beneficiary is the community, because we get services”*. They also said that they thought men and women benefitted equally. In general, it appeared that those who used the services themselves said they thought everyone in the community benefitted equally. Those who did not use the services, in contrast, saw that the centre had benefitted some but not all.

Gender relations might to some extent influence accessibility to the services offered at the centre. Some of my female informants said they were not ‘allowed’ by their husbands to leave their home at night and therefore said they were not able to watch TV at the Energy Centre during the evening. I discussed this issue with some women in a focus group discussion. They said *“In our culture it is not allowed for a woman to move anywhere at night”*. Women are only supposed to stay in the home with their children, to prepare their food, and if they went out somewhere the husband might suspect them of having a ‘boyfriend’. Then *“he might decide to chase you away from the family”*, one woman said. These women said they had never been to the Energy Centre at night, only during the day. However, I did see some women watching TV at the Energy Centre during the night when I visited Ikisaya. The staff at the Energy Centre also said that some women do come to the news at 7pm. The variation between what is considered as cultural norms and practice appear to be a reflection of differences between households in how strictly the husbands enforce the rules.

From the above, it seems clear that not everyone in Ikisaya is able to access the services at the Energy Centre. Accessibility to the services is constrained by income poverty, distance from the Energy Centre and gender dynamics. However, those who cannot use the services themselves might benefit from the Energy Centre in various indirect ways, by altering the general vulnerability context of the village.

6.1.2 Livelihoods

As mentioned in the previous chapter, economic factors contribute to vulnerability in Ikisaya. Income poverty rates are very high; very few have formal employment, and the majority of people rely on climate-sensitive livelihoods, such as farming. Frequent harvest failures contribute to low and erratic income from selling crops. This section will examine findings from my fieldwork regarding how both the services offered at Ikisaya Energy Centre and the Energy Centre in itself influence the economic situation and livelihoods in Ikisaya.

6.1.2.1 Solar lanterns and livelihoods

Findings indicate that the portable solar lanterns contribute to supporting livelihoods in a variety of ways. Renting portable lanterns at Ikisaya Energy Centre costs 280 Ksh³⁴ in a month (of 28 days). To be able to rent lanterns, you must first pay a deposit of 200 Ksh, and then pay 20 Ksh for charging every second day. 26 of my 50 informants said they normally rented the lantern, while the remaining 24 said they could not afford it. Of those who do rent it, 18 said they save money on using the lantern compared to using kerosene lamps. 8 said they do not save any money, but they preferred using the lantern instead of kerosene for various other reasons, and therefore rented it even though it was more expensive for them.

I asked my informants how much they normally spent on kerosene per month to see if the lantern is cheaper or more expensive than kerosene. However, the amount they reported to spend on kerosene varied from as little as 50 KSh per month up to as much as 700 Ksh per month. The number of hours people use the kerosene lamp for light thus varies considerably. In general, it seemed like those who said they used to spend more than 300 KSh per month on kerosene, had started using the lantern instead. Therefore, those who normally use a lot of kerosene save money on using the lantern instead. A household who used to spend 700Ksh per month on kerosene saves as much as 420 Ksh per month, while those who normally spend less than 280 Ksh per month on use kerosene do not save money on using the lantern instead.

Those who do save money on using the lantern compared to kerosene can spend this money on something else. For example, when asked if the money he saved on using the lantern was helpful during the drought, one informant answered;

³⁴ 250 KSh = 3,78 USD (Exchange rate: 0.0151, per 07.05.13).

Yes, yes, it helps, because if you compare the amount which was used on kerosene, and the one used on the lantern, you find that the one used on kerosene was a lot of money, as compared to the lantern. So the amount that was used on kerosene, now could be used even put to somewhere else financially. Support you financially in another area.

This illustrates that those who save money on using the lantern can spend this on items that are important during difficult periods, such as buying food, paying school fees, investing in hybrid seeds and so forth. Saving money can thus contribute to increasing coping and adaptive capacity.

Some of my informants said that there is low supply of kerosene during the rainy season, because the trucks transporting kerosene to the area is restricted by impassable roads. For example, one shop owner selling kerosene stressed that it is difficult to get kerosene during the rainy season. He normally did not rent the lanterns at the centre, since he was selling kerosene himself and found it to be easier to just continue using the kerosene lamp, but he would rent the lantern if there was a shortage of kerosene. Thus, having access to the lanterns can assist people during the rainy season, when kerosene is not available.

Furthermore, the price of kerosene fluctuates according to oil prices at the international market. Some of my informants said the price of kerosene had increased since the Energy Centre opened, and they attributed this price increase to be a result of the opening of the centre. They argued that because the demand for kerosene in Ikisaya had gone down, the price had increased. Shop owners I interviewed confirmed that the demand for kerosene had gone down since the Energy Centre, but the price increase was not caused by the Energy Centre, it was rather a result of higher market prices. Using the lantern instead of the kerosene lamps provide freedom from price fluctuations on kerosene, and is as such more predictable. This finding corresponds to the findings from another study of Solar Home Systems in Kenya by Acker and Kammen (1996). The lower demand for kerosene however reduces incomes for shop owners somewhat, but they said the revenues from selling kerosene were marginal, and they therefore did not see this as a problem.

Another effect of the portable lanterns is that they enable activities in the evening and extends working hours. Those of my informants who use the portable lanterns said they were now able to do activities in the evening that they were not able to do before. For example, a female informant said; *“If there is anything I should do during daytime, but I do not have time to do it, then I can use the light from the lantern to assist me in doing it in the evening instead”*.

This is especially helpful for women, whom during the dry season have to walk for hours to fetch water, and normally come home very late. When they have the lantern, they can then do household activities in the evening. The extra hours of light also allowed them time to do handicraft-production after they have done all the household work they have to do. My informants said the light from the lantern is brighter than the light from the kerosene lamps, and it is therefore easier to do activities in the evening, such as making handicrafts.

The lanterns are also used by some of the restaurants and shops in the evening, and have allowed them to keep open for longer hours. They said that many people now come to the restaurants or shops in the evening, and they therefore make more money on their business. A key informant said; *“Before they had to close the shops and restaurants at 6-7 pm, and then they went home. But for now, even at 9 pm, the business is still going on. Therefore, the economy has grown”*. I also saw this for myself when I visited Ikisaya; even at 9 pm people were enjoying a cup of tea in the restaurants or sitting outside shops enjoying a soda.

In addition to providing livelihood options or saving fuel costs for some, lanterns also saves time, an important factor for households where labor is a critical resource for livelihoods and coping strategies. Further, the bright light from the lantern might help people do some activities *faster*. For example, a few of my informants mentioned that cooking was easier when they used the lanterns, and that they could cook faster. One informant said she normally just used firewood as a torch when she was cooking before she got the lantern. She would hold the ‘firewood torch’ in one hand, and would then just have one hand available to for example knead the chapatti dough. Having the lantern allowed her to use both hands when cooking, she said. The bright light from the lantern and the saved time might thus enable women to do activities in the evening that provide them with an additional income.

Although the lanterns provide people with ‘extra time’ in the evening, delivering the lantern for charging every other day can also be a time-consuming activity for some. Almost all of my informants who use the lanterns say it is not a problem for them to deliver the lantern for charging during the dry season, because they already have to go to Ikisaya market to fetch water or buy food. If they are not going to the market themselves, their children can bring the lantern to the Energy Centre before school, and pick it up after school. Yet, a few of my informants said having to deliver the lantern for charging every other day was inconvenient for them. A male informant living about 4 km from the Energy Centre said; *“After two days, whether you like it or not, you have to bring it back for charging. Whether you have another*

business or not". 'Unnecessary' travels to Ikisaya to charge the lanterns might therefore be a burden for some; the time they spend on going to the Energy Centre could have been spent on doing income-generating activities, such as doing casual work.

Another positive effect of the portable lanterns identified by my informants, is that it allows children to do homework and attend tutorial classes at the primary school in the evening. Improving education can have an indirect positive effect on poverty and unemployment; children who are able to do more homework might get better grades, further their chances of being admitted to secondary schools and higher education, and might thus further their possibility to get salaried employment in the future. Many of my informants said they had started renting the lantern because they wanted their children to do their homework at home in the evening. They said it had improved reading and writing-abilities of their children. A teacher at the local primary school said he could see a difference in the performance in the children since before the Energy Centre opened. He said the children from families who rent the lanterns do better at school than they did before they got the lantern, and they do their homework more thoroughly.

Hence, the lanterns may contribute to addressing lack of education, which was one of the conditions identified in chapter 5 as causing vulnerability. As mentioned, the light from the lantern is brighter than the light from the kerosene lamps, and my informants said that it is therefore better to study using the light from the lanterns. They argued the dim light from the kerosene lamp make the children strain their eyes when doing homework, and the lantern is not as tiresome on their eyes. A male informant said; *"I was pressed by my children to go get the lantern. Because the light, as compared to kerosene, it is brighter. It does not affect the eyes"*. Some of my informants said that before they started renting the lantern, their children did their homework at home in the evening, using a kerosene lamp or just the light from the fireplace. Others said their children did their homework at school, before or after the classes. Those who did not rent the lantern said the same. For example, a female informant who did not rent the lantern said; *"They normally don't do homework at home. There is no light to help them in the house, so they normally do their homework at school before or after school"*. Furthermore, the issue of water scarcity impacts the homework of children in families who do not have light at home. During the dry season some children have to fetch water for their family, and then do not have time for doing homework after school. A teacher at the primary school said; *"The problem of this place is water. Some, after they are released here at school, they have to go and fetch water. So maybe they come home late, and can't do it at that time"*.

In addition to helping children do homework at home during the evening, solar lamps from the Energy Centre are used to have evening ‘preps’ (additional tutorial classes to prepare students for upcoming exams) at the primary school for pupils in the 7th and 8th grade. At the end of primary school, pupils have to take the Kenya Certificate of Primary Education (KCPE) exam. According to an informant, the results they get on this exam determine which, if any, secondary school they will be admitted into. Students who do well on this exam will be admitted to better secondary schools than those who get poor exam results. The evening preps are supposed to help the pupils get better results on the KCPE exam. Therefore, attending the evening preps might further a students’ probability of being admitted to a good secondary school. However, according to a teacher at the primary school, not all of the students come to the classes in the evening; *“The problem is that not all of them come for the preps. Because we don’t have boarding facilities. So those who come from far cannot make it. Because the parents have to wait for their children to take them home. So when the parents don’t have time, the children have to go home”*.

Therefore, the lanterns are helpful to the children who have parents who can afford renting the lanterns, the children who are able to come to the evening preps and children from families who can afford sending them to secondary school and college. Yet, the lanterns do not benefit the children in poorer families and children in families who live far from the school as much.

Although the solar lanterns might improve children’s performance at school, many parents cannot afford to send their children to secondary school, much less send them to college. Doing more homework does thus not necessarily lead to getting a higher education. Those who are fortunate enough to get higher education are also not guaranteed to get a job. There are few employment options in Ikisaya, and they might have to migrate to find employment. Even if they do migrate to the big cities, they risk not finding a job there either, as unemployment is very high in Kenya in general (UNDP 2013). I heard of several young men from Ikisaya who had high education, who had moved to Nairobi to find a job, but who was unemployed and only got random casual jobs. Yet, having secondary or higher education does improve the chances of getting formal employment, and is thus still important.

As mentioned in the previous chapter, remittances from family members with employment in the cities are an important source of income for many people in Ikisaya. Remittances are especially important during droughts. Therefore, enhancing education might indirectly lead to increased remittances by furthering the chances of formal employment for some. The

educational benefits of the Energy Centre services can hence indirectly improve the financial situation and adaptive capacity for some people in Ikisaya, by furthering chances of getting formal employment for some, which in turn can contribute to increased flow of remittances to their family members.

6.1.2.2 Cellphones and livelihoods

Access to cellphone charging at Ikisaya Energy Centre also has an impact on poverty and unemployment in the area, another factor causing vulnerability. The majority of my informants owned a cellphone; 36 owned a cellphone, while 14 did not. Of the 36 that owned a cellphone, 25 said they normally charged their cellphone at the Energy Centre. The remaining 9 said they charged their phone at other shops offering charging services in Ikisaya or at home (with a solar panel they have bought at the Energy Centre or bought elsewhere before the Energy Centre opened). Most of my informants said that before the Energy Centre opened, they used to charge their cellphone at the shops in Ikisaya, at the home of people who owned solar panels, or in Endau. They said the Energy Centre had reduced the time they used to spend on travelling to Endau or to other people's houses to charge their cellphone. Furthermore, some of the people I talked to told me they now charged their phone more frequently than they did before the Energy Centre opened because they did not have to travel as far to get the service.

However, one potentially negative impact of the Energy Centre providing cellphone charging is the competition it poses to those who offered charging services before the Energy Centre opened. Most of the shops and individuals who own solar panels in Ikisaya are still 'selling' cellphone charging, but some of them do not receive the same amount of customers as they did before the Energy Centre opened. One female informant said she had a solar panel in her home. She said; "*When the centre was not here, I used to get many customers to my place to charge their phones*". The competition from the Energy Centre has thus reduced the income some people get from offering cellphone charging. Nevertheless, those I talked to said that they did not see this competition as a problem. They wanted the Energy Centre to flourish, because they wanted to use the other services they offered at the centre themselves and saw the centre to be a benefit to the entire community. The benefits generated by having the Energy Centre in Ikisaya thus made up for the reduced income they got themselves. Some also still go to the shops and individuals offering cellphone charging instead of going to the Energy Centre. They said they wanted to support their friends' business.

My informants said there are many benefits of having a cellphone, and that it in various ways provide them with an extra income. First of all, the cellphone is used for communication regarding casual labor. If a person needs help, he or she can call people to offer them casual work. The casual laborer and employee can easily communicate with each other. As mentioned in the previous chapter, casual labor is an important coping strategy in Ikisaya. Cellphones can thus contribute to enhancing coping capacity. Secondly, cellphones are used for business. The shop and restaurant owners can communicate with their suppliers and order items, or call people to bring things to them from the large Thursday-market in Endau. Other businesspeople also said they use their cellphone to communicate with both customers and suppliers. These people said having a cellphone was very important for their business, and thus provided them with an extra income. Doing business is also an important coping strategy. Thirdly, a few of my informants said they used their cellphone to sell crops. They said they used their cellphone to contact middle traders, who buys the crops from them and bring it to urban areas to sell it for a higher price in better markets. However, according to a key informant, the majority of the people in Ikisaya just brings their produce to the Thursday markets in Endau and sells it there, or sells it to the local shop owners in Ikisaya. They do not use a cellphone in this trade.

Having a cellphone might also reduce the time spent on communicating with others. When you do not have a cellphone, you either have to travel in person to whomever you want to communicate with, send a message through another person or send a letter. A female informant said; *“Before I had to go by foot to somebody if I needed anything, but now I can call from where I am”*. A male informant also said; *“If someone is far away, I can easily and quickly talk to him. Before, we sent a letter. It took many days. But now life is simpler. If someone is in Endau, we can just talk.”* Cellphones thus reduce the time spent on communicating with people; time that can then be spent on doing other activities.

The M-Pesa system is another way in which people get money through their phone. Several of my informants said they could call family members or friends if they needed money, and they could just transfer money to their phone through M-Pesa. For example, a female informant said; *“I can call somebody from far when I have problem with money, and that person can send me money through the phone”*. Money sent to their phones can then be withdrawn at a shop at Ikisaya market, or in Endau. The M-Pesa system is thus a good way for people to receive remittances from family members who have migrated to cities for employment. This is especially helpful for women whom their husband lives and works elsewhere.

My informants also said cellphones are helpful for the ‘illegal’ coping activities of *hunting wild game* and *selling Kaluvu*. Cellphones are used to warn hunters if patrollers from Kenya Wildlife Service are spotted in the area. For example, a hunter I talked to said; *“I monitor where the patrollers are. If they are seen somewhere, I am told by my friends. I get called on my cellphone and told where they have been seen. We help each other”*. The ability to be warned through cellphone by others when hunting might thus in a way encourage hunting, because it lowers the probability of being caught and arrested. Cellphones are also used in the trade of Kaluvu. My informants said if people are having a function, they can call women who produce Kaluvu and order large quantities of the local brew from them.

Cellphones can thus contribute to increasing incomes, receiving remittances and saving time, which can be spent on doing income-generating activities. However, patchy cellphone coverage in Ikisaya hinders widespread cellphone communication. People currently have to go to certain spots to get network on their cellphones. These spots are sometimes located far from peoples’ homes. This means that even though people have a cellphone, they might not be reached at all times, and they might have to travel to a certain spot to call others. A statement made by a female informant during an interview illustrates this problem; *“we are charging our phones there, but there is no network here!”* If cellphone towers are installed in the area, the positive impacts of having access to cellphone charging will greatly increase. It is however important to emphasize that people were able to charge cellphones before the Energy Centre opened as well, and these above-mentioned benefits of cellphones are thus not only a result of the Energy Centre. Yet, the centre has improved availability of charging services in the area.

6.1.2.3 Television and livelihoods

I did not find any direct impact of access to television on unemployment in Ikisaya. Yet, there might be some indirect effects of television on livelihoods. First of all, the TV provides weather forecasts that might be useful to farmers in Ikisaya. The timing of planting, and the type of crops to plant, could be influenced by information spread through the news at the television. If the meteorologists forecasts that it will start raining on a certain date, the people in Ikisaya can prepare for this and plant accordingly. However, many of my informants said they did not trust the weather forecasts. They said they were not reliable and seldom accurate. Some of my informants also said that they did not pay attention to the forecasts, because God controls the weather. For example, an informant said that the weather forecasters are only

humans; they don't know how the weather will be in the future. Only God knows. Others said that they only used their own, traditional, methods of predicting the weather as a guide for planning their agricultural activities. Very few said they used the information about the weather they got from the radio or TV to plan their farming activities. Therefore, the effect of weather forecasts on the economy of people in Ikisaya seems to be fairly minimal.

Another way TV can have a positive effect on livelihoods is through the spread of information. The news at the TV spreads information about current events that might have an influence on Ikisaya. The TV can therefore in a way act as an "early warning system". However, many people in Ikisaya have radios powered by dry cell batteries, and important information is already spread through the radio. The TV is as such not crucial for dissemination of important news and information. Thirdly, the TV is sometimes used by the primary school to show educational films to students. The films are nice supplements to lectures and written materials in education. My informants said that the educational films, as well as the news and movies, educate children in the village and increase their knowledge. The TV thus has educational benefits.

Finally, some of my informants said the TV has reduced alcoholism in the village, because men now can go to the Energy Centre to watch TV instead of going to the bar or drinking Kaluvu with friends in the evening. Drinking alcohol on the premises of the Energy Centre is prohibited, and people who are drunk are not allowed into the TV room. Therefore, if men want to watch TV in the evening, they cannot drink alcohol. For example, upon a question about the benefits of the TV, a male informant said; *"I save money on watching TV instead of drinking...When I go there I don't waste a lot. Before I used to go drinking instead, now I go to see TV instead"*. When men opt to go to the Energy Centre to watch TV in the evening, they spend less money. This money can then be spent on necessary items for their family or kept as savings instead. Reduced alcoholism could also have a number of non-economic benefits, such as reducing alcohol-related health problems, reducing domestic violence and so on.

6.1.2.4 Computer Services and livelihoods

Ikisaya Energy Centre offers computer services such as typing, printing, and photocopying. Having access to such computer services within the village saves people from time-consuming and costly travels to towns offering the same services. Of these computer services,

the photocopy machine is used the most. 27 of my 50 informants said they had used it at least once to copy documents, such as personal ID's and birth certificates, since the centre opened. They were very pleased that they now have this service in Ikisaya. Previously they have had to go to Endau, Zombe or Kitui to photocopy documents. They therefore said having this service in Ikisaya saves them time and money. For example, an informant said; *“Before we had to go elsewhere, now I save time. When I need to photocopy something, I just come here, which is very near, and it is available for me...Before I wasted time going elsewhere, so it saves me time to do other things”*. The ID's are used to access certain services, such as receiving food aid from the government. Computer services such as typing and printing are also helpful when organizing fundraisings; invitations can be typed and printed at the Energy Centre and used for mobilization.

6.1.2.5 Direct employment benefits of Ikisaya Energy Centre

One positive effect of the Energy Centre in itself is that it has employed some people to work as staff at the centre. The centre has in this way contributed directly to offering much needed employment. My informants said they were very happy that the people working at the Energy Centre come from Ikisaya. They were referred to as 'their' people, illustrated by a statement by an informant; *“It is employing our people! Employment is scarce here, so that is one important benefit”*. Further, many people said the employment of people had positive side-effects to others in the community. For example, an informant said; *“The centre has employed some people from this community, which is being paid, and now, what they are being paid now, they will spend to help themselves, and even the entire community. And that is also a benefit to the entire community”*. The staff at the Energy Centre has become frequent visitors in the local restaurants to have tea or lunch during the day. This has increased revenues for the restaurant owners.

Ikisaya Energy Centre has also attracted many visitors to Ikisaya, both from other areas of Kenya and abroad; researchers from the Solar Transitions research project, students such as myself, journalists, photographers, businessmen and others interested in studying the Energy Centre. These visitors spend money in Ikisaya; buy food in the restaurants, Coca Cola in the shops, handicrafts made by local women and so forth. Some of these also hire people to act as translators and research assistants, and pay for accommodation and transportation. The influx of visitors to Ikisaya has thus increased the income of some people and created temporary employment for some. However, the benefits accrued from visitors have not necessarily been

distributed equally in Ikisaya. This will be discussed in more detail later in this chapter, in relation to the impacts of the Energy Centre on social and cultural dynamics.

6.1.2.6 Summing up livelihoods and adaptive capacity

When I asked my informants about the positive effects of the Energy Centre on the community of Ikisaya in general, most people said that it provided services in Ikisaya that they before had to travel far to access. The presence of the Energy Centre has thus reduced the time and money spent on travelling to other places to access the same services. For example, one informant said: *“It saves people time and money. Just take for example, travelling from here to Zombe, you have wasted a lot of time and energy, you can get it just here. You are maybe paying for somebody to take you to Zombe and back, and that is expensive”*. The time saved on accessing services in Ikisaya can therefore be used on doing other important activities, and the money saved can be spent on necessary expenses or invested in adaptive measures.

In summary, Ikisaya Energy Centre influence livelihoods in a variety of ways. Some save money, time, get an additional income and some get employment. The services offered at the Energy Centre assist the coping strategies people employ during periods of stress, and increase the coping capacity of people. There might be other effects of the Energy Centre on livelihoods and adaptive capacity than those I have outlined here, but these were the most evident when I visited Ikisaya in October 2012. The Energy Centre may also have other positive or negative side-effects in the future that are not yet visible or foreseeable.

6.1.3 Politics and infrastructure

Political marginalization and lack of public funding to infrastructural development was identified in the previous chapter as factors contributing to contextual vulnerability in Ikisaya. When I visited the area in October/November 2012, I had some informal discussions with politicians that were campaigning in the area prior to the national elections in March 2013. They expressed that they were impressed by the Energy Centre project, and one politician said that the Energy Centre had made Ikisaya famous. The Solar Transitions research group has also communicated with various government officials during the process, such as

representatives from the Ministry of Energy, Kenya Power³⁵ and the District Commissioner (D.C.) of Kitui (Ulsrud, personal communication, May 2013). The Energy Centre seems to have increased the status of Ikisaya. The remote village has in a way been ‘put on the map’, not only in Kenya, but it has also generated media publicity in Norway³⁶. The Energy Centre project thus seems to have led to an increased political awareness about Ikisaya. It is possible that this increased awareness might have implications for political allocations of funding for infrastructure in the area; when politicians are to decide where to allocate funding for example for road improvements, the Energy Centre might make them think of Ikisaya. Thus, although the Energy Centre does not have any direct impact on infrastructural challenges in the area, such as poor roads, it might have an indirect impact through political awareness. However, it is difficult to know at this point how much effect this increased political awareness might have for Ikisaya.

As mentioned in the previous chapter, the national electricity grid has not been extended to the Ikisaya area yet. The Energy Centre has therefore directly contributed to increasing the access to electricity in the area. However, the grid is now coming to Ikisaya. A representative from Kenya Power said on April 12th, 2013, that the electricity grid will be extended to Ikisaya, because it is going to power public schools and government institutions in the area (Gichungi 2013). Although this is great news for the schools, I doubt that individuals in the community will afford connecting themselves to the grid and installing electrical appliances in their homes. According to Kirsten Ulsrud³⁷ (personal communication, 09.05.13), the price of connecting to the electricity grid in Ikisaya will most likely cost 17,000 KSh³⁸ in the beginning, and then increase to 35,000 KSh³⁹ after a while. This price is most likely too high for the majority of the people in Ikisaya.

Even if some people were able to connect to the grid, it does not seem likely that the Energy Centre will become obsolete. The centre provides access to services that most people otherwise would not have access to within their vicinity. The services offered at the centre are also more flexible than grid connection. As most people in Ikisaya have a seasonal income

³⁵ Kenya Power is a public company that transmits and distributes electricity in Kenya. Read more about Kenya Power on: <http://www.kplc.co.ke/>.

³⁶ See for example the article “Tror solenergi kan være lønnsomt” in Bistandsaktuelt (07.05.12), <http://www.bistandsaktuelt.no/nyheter-og-reportasjer/arkiv-nyheter-og-reportasjer/innovativ-modell-for-1%C3%B8nnsomt-solenergi>, and the article “Henter vann og strøm i samme slengen” in Apollon (02.04.2013); http://www.apollon.uio.no/artikler/2013/1_energi_kenya.html.

³⁷ Project leader of the Solar Transitions research project

³⁸ 17,000 KSh = 257 USD (Exchange rate 0.0151, per 13.05.13)

³⁹ 35,000 KSh = 530 USD (same as above).

from farming, paying a monthly tariff for electricity in their homes is extremely difficult. The pay-per-use system at the Energy Centre allows people to use services only when they afford them. However, some shopkeepers and restaurant owners might perhaps be able to afford connecting themselves to the grid, and could in that case start offering services competing with the Energy Centre. The grid might thus perhaps impact the viability of Ikisaya Energy Centre.

As explained in the previous chapter, there are no dispensaries or hospitals in Ikisaya. The Energy Centre has not improved the access to healthcare services within the village, but cellphones can be used to call for help if a person requires acute medical attention. For example, one informant said one benefit of having a cellphone, is that if you are injured in any way, you can call someone who can help you get to the dispensary or hospital. Another informant said; *“If you get a snake bite you can communicate with people and they can rush you to the hospital. Or if you are hurt when you are plowing your shamba with bulls.”* The cellphone can thus be used to for example call someone owning a motorcycle that can transport the injured person to the dispensaries in Endau or Malalani, or the hospital in Kitui.

Although Ikisaya Energy Centre seem to have only one direct effect on access to health care, the services provided by the centre might in various ways have positive benefits to the health of people in the community, and thus reduce the *need* for healthcare. My informants identified many positive health benefits of using the portable lanterns when it comes to health. First of all, kerosene lamps produce fumes that are unpleasant and can be harmful to health (See for example Muller et al. 2003). Many of my informants said that one of the reasons why they had started using the solar lantern instead of kerosene lamps was because of health considerations; they complained about unpleasant soot or fumes from the kerosene lamp. This was also a reason identified by some of those who wanted to start using the lanterns, but said they could not afford to. For example, one informant said she got rashes on her body from the fumes of the kerosene lamp, another said the fumes hurt her chest and made it difficult to breathe. Another informant also said the soot hurt her eyes, and that her children complained that the kerosene fumes ‘blocked’ their noses. Reduced indoor pollution is thus one positive benefit of the portable lanterns when it comes to health issues.

Further, kerosene lamps can cause accidents or fires. My informants said kerosene lamps can cause burn injuries or they can set fire to the thatched grass roofs that many houses in the village has. *“Those things can burn your house!”* an informant said. The portable lanterns can

prevent burns and injuries inflicted by kerosene lamps, and some of my informants used this as a reason for why they used or wanted to start using the portable lanterns. My informants also said the bright light from the lanterns helped prevent snake bites. For example, an informant stated that; *“When I place it in the room, I can see every corner of the room. So if I see a snake that has entered the room, I can see it and kill it”*. The portable lanterns can also be used when going to the latrine during the night and thus prevent people from being bitten by snakes or scorpions.

None of my informants mentioned that portable lanterns can be useful during home childbirths at night, and I did not ask about this explicitly. However, as most of the women give birth at home, I would assume that the bright light from the portable lanterns are better to use than kerosene lamps, and could perhaps reduce childbirth risks.

6.1.4 Conflict and tensions

Violent raids and tensions between the settled Kamba population and nomadic pastoralists was also identified as a driver of vulnerability in the previous section. I did not find any apparent effects of Ikisaya Energy Centre and its services on dynamics of the dispute with nomadic pastoralists. However, access to lanterns and cellphone charging might have some effects on *security* in the community. Some of my informants said the lantern increased their feeling of security; if they heard anything outside their house in the evening, they could use the light from the lantern to see what it was. This made them feel more secure in terms of raids from Kenyan-Somali pastoralists. They also said cellphones made them feel safer; if they were themselves raided by someone, they would call others for help, or they could be warned by others in the community if someone else had been raided. Then they could take their most precious belongings and run into the bush and hide, until the pastoralists had left the area. Some of my female informants also said they felt safer when walking home in the dark. One female restaurant owner in Kalwa said she used the portable lantern to light her way when she walked home from the restaurant in the evening. She said she felt safer when she had the bright light and could see everything. The lanterns can thus perhaps prevent violent attacks and sexual violence, and increase security especially for women.

6.1.5 Socio-cultural dynamics

Projects being implemented in a community are seldom disentangled from social dynamics, and any project might influence power relations in a community in various, often unforeseen, manners. Ikisaya Energy Centre is not an exception. The Energy Centre project has been implemented in a community characterized by a certain degree of clan differences, socio-economic inequality and gender disparity. This part will investigate how Ikisaya Energy Centre and its services impact social and cultural dynamics and asymmetric power relations in the community. This issue is also relevant to the second principle of sustainable adaptation; acknowledging that different values and interests affect adaptation outcomes (Eriksen et al. 2011).

When I visited Ikisaya in October 2012, I noticed that there was some ‘dissatisfaction’ in the community regarding the Energy Centre. Many were not willing to talk to me about this openly, and just said they had heard that some people were frustrated with regards to the Energy Centre, but they would not say why. However, some of my informants were willing to talk about this freely with me. They said the Energy Centre and the project had been entangled in ‘internal politics’ in the community. A few of my informants said these ‘internal politics’ had led some to spread negative rumors in the community about the Energy Centre before and immediately after it opened. I talked to one of the staff members at the Energy Centre about this. The staff member said;

You know, politics, it's almost everywhere. There are some people who normally goes against everything even if it is good, even if it's bad. We had such kind of infiltration initially, but you see, we overlooked it, overlooked them altogether, and they talked, they did a lot of things, and we do not have any issue with them. And then later on, the same same people now started using the services, when they realized that there was nobody who was after them, chasing them. Now everything is right, the people who initially were obstructing people from using the services, today they are the first ones to come for the services.

The initial skepticism to the Energy Centre appears related to a fear that the project was going to benefit some clans more than others. According to my informants, some did not think the Energy Centre would benefit everyone in the community equally, and they therefore boycotted it. However, these tensions seemed to ease after people started feeling that they also had an influence on the project and was involved in the process.

However, ‘internal politics’ seemed to have resurfaced again in September/October 2012, as a result of various issues. My informants said that people were complaining that some members from one large family, within one clan, were dominating the entire project, and were benefitting more than others in the community. As mentioned in the background chapter, the Community Based Organization of Ikisaya Energy Centre is managed by a board. The CBO had an election for a temporary board, a committee interim, on May 25th 2011. The CBO was then supposed to have a new election for a permanent board after 6 months. The members in the committee interim could then be elected to continue in their seat, or they could be replaced. However, the committee interim had not yet called for an election when I visited Ikisaya, and people felt the members in the temporary board were trying to hold on to their position by avoiding a democratic election. During an interview, an informant explained why some people were dissatisfied with the Energy Centre project;

When we were going to start, we had some papers come ...who said we should have a committee interim. From then everybody should select a committee, from there after 6 months, we come to make a full election. But that has not happened. That is a problem, so people are complaining. If you have a chicken, and it makes a noise at night, you have to see why it made a noise. You would like to know what the noise is. So you need to find the reason. And the problem is that they were to be the interim board... So we have some problem with the board. The election is not well. Let it be open. From the top to the down.

I was further told that another reason why many people in the community were discontent with the board, was that the chairman in the interim committee and the employed manager at the centre were cousins. They came from the same clan. They were also related to one of the people involved in the Solar Transitions research group, a man just referred to as ‘the coordinator’ by some. A key informant said during an interview;

There has been a problem with the management. There has been a problem with the board. Because the chairman and the manager were cousins. The coordinator was a cousin. And the community thought that “Oh, what is happening?” Most thought that this was a project made for individuals, and not for the entire community.

Another informant said;

You know this man...Most of the people in that place are from his family. From his family. And now the community members are complaining. Why them? Has it become a family issue? Or if it is a community project, then; Why? Why? There is that question among the community members. And it is a true one. Even some others have decided not

to come to this place, because it has become theirs. So that also needs to be taken care of. Because now when people keeps off from the place, it means nothing is going to happen. When they come and let it be the family members, and leave the family members to attend there, automatically it is going to become a failure.

Many people in the community thus seemed to feel that the Energy Centre project was led and dominated by members from one family; one clan. The predominance of members from the same clan in the management of the Energy Centre thus made some people frustrated. For example, one informant said; *“The problem is balancing... Here we have so many clans, it is better to share equally, all clans must be represented. One family should not have all chairs”*. This seems to illustrate how important it is for the local community that people from different clans are represented in community projects.

Not only was the community in Ikisaya dissatisfied with the lack of election within the CBO, they were also missing public meetings (Baraza's) where the members could voice their opinion about how the centre should be run, and where they could get information about the Energy Centre. For example, one informant said; *“It would be good for the board to call a baraza, and take views from the people about how they want the centre to be. Get views from rich and poor people”*.

Furthermore, during my fieldwork, I was told that there were some rumors going around in the village saying that the Energy Centre was corrupt. According to the rumors, some members of the staff and committee interim were taking surplus from the Energy Centre and putting it into their own pockets, and because the chairman in the board and the manager were related, this 'scheme' was covered up. As a result of these rumors, and the discontent with the management, some people said they had stopped using the services in protest (This will be discussed more in section 6.2.2).

In addition to these issues, some of my informants said they felt that the benefits generated by the influx of visitors to Ikisaya coming to see the Energy Centre were 'seized' by members of the same clan that dominated the Energy Centre project. The visitors were usually accommodated with members of the same clan, and used members of this clan as research assistants, translators or drivers. Some people felt that employment opportunities, which are very much needed in the community, were given primarily to members of this clan. Sometimes the temporary employment was not even given to people living in Ikisaya, but relatives of the same family actually living in other parts of the country. The benefits and

employment options were thus not distributed equally among members of the community, and this caused some frustration among those who felt they did not benefit.

The ‘frustration’ in the community seem to have eased somewhat after I visited Ikisaya. The board rearranged the staff, and reduced the number of staff from five to four employees, after advice from the Solar Transitions project team. This was not only necessary to reduce dissatisfaction in the community, but also necessary in order to reduce salary expenses and get a functioning leadership at the centre. The committee interim has also attempted to hold elections twice since October 2012, but not enough members of the CBO came to the election meeting to gain majority votes. Thus, as of May 12th, 2013, there has not been an election for the permanent board in the CBO, but it is in planning now (Ulsrud, personal communication).

As discussed in chapter 5.5, power asymmetries are not only based on clan affiliations, but also on socio-economic status. Some people in the community of Ikisaya have a higher status than others, based on level of income, employment, educational level and so on. Positions in a board of a community group also seem to give individuals higher socio-economic status. Some of these ‘elite’ people were elected to the board of the CBO of Ikisaya Energy Centre. For example, the chairman of the CBO is one of the wealthiest men in the village; he has high education and speaks perfect English, he has been in the Kenyan army, and lived in Nairobi for a while. The vice-chairlady also is also one such privileged individual with high socio-economic status in the community. She is also currently the chairlady of another important community group in Ikisaya. Some of the board members of the CBO are also among the ‘village elders’, whom already have great power in local decision-making processes.

It seems to me that the Energy Centre has consolidated the power of some of these ‘elites’ in Ikisaya. I asked one man from Ikisaya in an informal conversation why members of the village elders, people with high socio-economic status, were elected to be members of the committee interim of the CBO. He said; *“Because they are people with the qualities people think are useful for such a position”*. He further said that the problem is that of democracy, majority votes and clan affiliations; if people vote for representatives within their own clan, these clans end up dominating different boards in the community, such as the Ikisaya Energy Centre CBO.

However, it was indicated to me during fieldwork that some people do not ‘dare’ to vote openly against these ‘powerful’ people in the community in elections such as that for the

Ikisaya Energy Centre CBO. When I started asking questions about this, one woman told me that these people are very powerful, and that one should not try to ‘go against them’. Fieldwork observations indicate that the people who were dissatisfied with the lack of elections and so forth did not want to voice their concerns publicly. When they told me about these issues, they asked *me* to forward their concerns to the Solar Transitions research group and have *them* sort things out. I asked one informant why people in the community didn’t demand information, election and transparency themselves, and he said;

To stand up and say ‘It is like 1, 2, 3’ people are fearing. People are fearing now. Because now, you know, people in this place of ours, tend to, they do not know their rights fully. So when somebody does not know his rights, he can be misused in any way. So when somebody wants to talk the right, and he has nobody to back him up, then it means, even if he talks, nothing happens. No one is going to consider it .

The Energy Centre seems to have ‘surfaced’ some underlying social and cultural dynamics in the community, related to clan-based and socio-economic power asymmetries. Some felt the ‘powerful’ people in the community was seizing control of the Energy Centre, and feared that the centre would benefit some more than others.

An important socio-cultural dynamic that shapes vulnerability and which may have been influenced by the Energy Centre, is that of gender relations. The Solar Transitions research group has focused on gender sensitivity throughout the process of designing, establishing and operating Ikisaya Energy Centre. Women have been explicitly asked to participate in and speak at public information meetings held by the research team. Women are also included in the board of the CBO and the staff at the Energy Centre; one of four or the staff members are female and 6 of 12 board members are female (Winther 2013). Further, of the 200 members in the CBO, 106 are women. The women in the community have thus shown a great interest in the project. It seemed to me during fieldwork in Ikisaya that women were very pleased that the project had focused so much on women; listened to their views and involved women in the decision-making bodies of the CBO and in the staff. It is possible that this gender sensitivity have an impact on gender relations in the community; women might get more confident and participate more in local politics. This was difficult for me to assess as I visited the area only six months after the Energy Centre opened, and changes in social and cultural practices and dynamics usually take a long time.

6.2 Impact of contextual vulnerability on Ikisaya Energy Centre

The previous section has delineated how the Energy Centre has impacted the vulnerability context in Ikisaya by addressing the drivers of vulnerability identified in chapter 5. This section will discuss how the vulnerability context in turn might influence the viability of the Energy Centre.

6.2.1 Climatic and economic factors

As discussed in chapter 5, income poverty levels are high in Ikisaya, and people generally have a low purchasing power. For example, a survey conducted by the Solar Transitions research team in 2011 found that the average daily wage for casual workers in Ikisaya was 100 KSh (Kirubi 2011). In general, lack of money was the main reason my informants gave for not using the services at the Energy Centre. The staff working at the Energy Centre confirmed to me that poverty was inhibiting many people from using the energy services. One of the staff members said; *“The problem is not that they don’t need the services. The problem is that they don’t have the means to meeting the services”*.

The purchasing power of most people in the area is not only generally low, but it also fluctuates greatly. Farming is the main livelihood for most people. They therefore have a seasonal income; they normally get the main bulk of income in January/February after the short rains and in May/June after the long rains. This money must then be distributed across the remaining months of the year, unless they do other activities to gain an income. Further, droughts frequently lead to harvest failures, meaning that the farmers do not get an income at all. Thus, high levels of poverty and unemployment, great climatic variability and recurrent droughts impair the purchasing power of people in Ikisaya and impact their ability to pay for services offered at the Energy Centre. Low and fluctuating purchasing power might affect the revenues generated by the centre, and thus challenge its viability.

For example, almost all of my informants said the prolonged agricultural drought made it more difficult for them to use the services offered by the centre. For example, a male informant said; *“I am suffering. I am affected by the drought. Sometimes I have the interest to go there to watch TV, but I lack money to use that service”* The staff at the Energy Centre said the number of customers had gone down in September and October as a result of the prolonged drought the community experienced.

One problem the Energy Centre experienced as a result of the drought in September/October 2012 was that some people wanted to *borrow* the lanterns from the centre, and pay when they got money. My informants said they usually borrowed kerosene, food and other groceries from the shops if they did not have money. This was a fairly important coping strategy for some as purchasing power fluctuates throughout the year. The customers were therefore complaining that they could not afford to pay 20Ksh every other day to rent the lantern, and wanted to pay back later, just like they did at the shops. One of my informants said she could not rent the lanterns and used the kerosene lamps instead, because “*There I cannot loan, but I can loan kerosene from the shops*”. This caused some problems for the centre. It was somewhat difficult for the staff at the centre to be strict with people, as they knew that people were struggling, and they sometimes allowed people to pay when they returned the lantern instead of when they fetched it. However, the centre lost some income from this, because some did not pay the 20Ksh extra when they came back. A staff member said they discovered in October that the income from the lantern hire the previous month had dropped. They went back and looked at receipts, and found that some people had borrowed the lantern with the promise that they would pay when they returned, but when they returned it, they failed to pay for the last one. Then they had to talk to the people concerned, and recover the lost income.

The staff became stricter as a result of this, and has not allowed anybody to take the lantern with them if they did not pay the 20Ksh upfront. The centre also started enforcing a ‘fine system’ in December 2012; giving out fines for late returns of the lanterns, to deter people from keeping the lanterns at home for a longer period than two days. Some people had just kept the lantern at home if they did not have money to charge the lantern every other day, but this reduced the revenues for the centre, as the lanterns could then rather be rented by someone who could afford to rent it instead of sitting at someone’s home without power.

6.2.1 Conflict and tensions

The ‘dispute’ with Kenyan Somali pastoralists also affected the demand for services at the Energy Centre somewhat during the summer of 2012. Most of my informants said they had feared going to the Energy Centre to watch the news at 7pm or watch other shows at night after the man from Ikisaya was killed on July 5th. The staff at the Energy Centre said they saw a reduction in the number of customers coming to watch TV during the evening in that period. Some of my informants said they slept in the bush for weeks after July 5th, because they feared the Somali pastoralists would retaliate, raid their houses and kill them. They said they

left their house before it got dark, and slept in the bush all night. Therefore, they did not go to the Energy Centre in the evening. Thus, security concerns might have an impact on the demand for some of the services offered at the centre and challenge the viability of the Energy Centre.

6.2.2 Socio-cultural dynamics

Section 6.1.5 discussed how social and cultural dynamics in Ikisaya have been influenced by the Energy Centre. Underlying clan relations and power asymmetries seemed to come to the 'surface' as a result of the Energy Centre. Some of my informants said they feared that the Energy Centre would benefit one family, one clan, more than others. This might have had an influence on the use of the services at the time. This section will thus investigate how social and cultural dynamics in turn might influence the viability of the Energy Centre.

As outlined in section 5.1.2, the Energy Centre seemed to have had two periods of dissatisfaction in the community since it opened in March 2012 and when I visited Ikisaya in October that led some to 'boycott' the services offered by the centre. The first occurred around the time the Energy Centre opened, as some people in the community were spreading negative rumors about the centre and boycotting the centre. However, this initial skepticism regarding the centre seemed to ease after a while, as people saw how the services could benefit them. People started trusting the project and using the energy services. Then however, problems seemed to resurface again six months later, in September/October 2012. Dissatisfaction related to the lack of a new election, lack of information and rumors of corruption made some people lose trust in the centre. Again, some people boycotted the centre and discouraged people to use the services. However, the dissatisfaction seemed to ease again after measures were taken by the board, after advice from the Solar Transitions project group; providing information to the community in public meetings, inviting members of the CBO to general assembly and election, and rearranging the staff at the centre.

Thus, it seems like clan relations and power asymmetries might impact the viability of the centre. My informants said they thought it was very important that the board of the CBO and the staff at the centre represented all the clans in the community and were not dominated by the 'biggest' clans. The principles of democracy, transparency and accountability also appeared to be very important for my informants; they wanted democratic elections for the board, they wanted to know how much money the centre generated and what was done with

this money, and they wanted to know that people would be held accountable if corruption was detected. It is therefore very important for the viability and sustainability of the Energy Centre that the board and the staff make sure that the principles of democracy, transparency and accountability are continuously upheld and taken seriously.

6.2.4 Viability of Ikisaya Energy Centre

Climatic and societal factors thus influence the demand for services offered by the centre and might challenge the financial sustainability and viability of the centre. Financial records from Ikisaya Energy Centre show how the demand for services has fluctuated somewhat during the first year of operation;

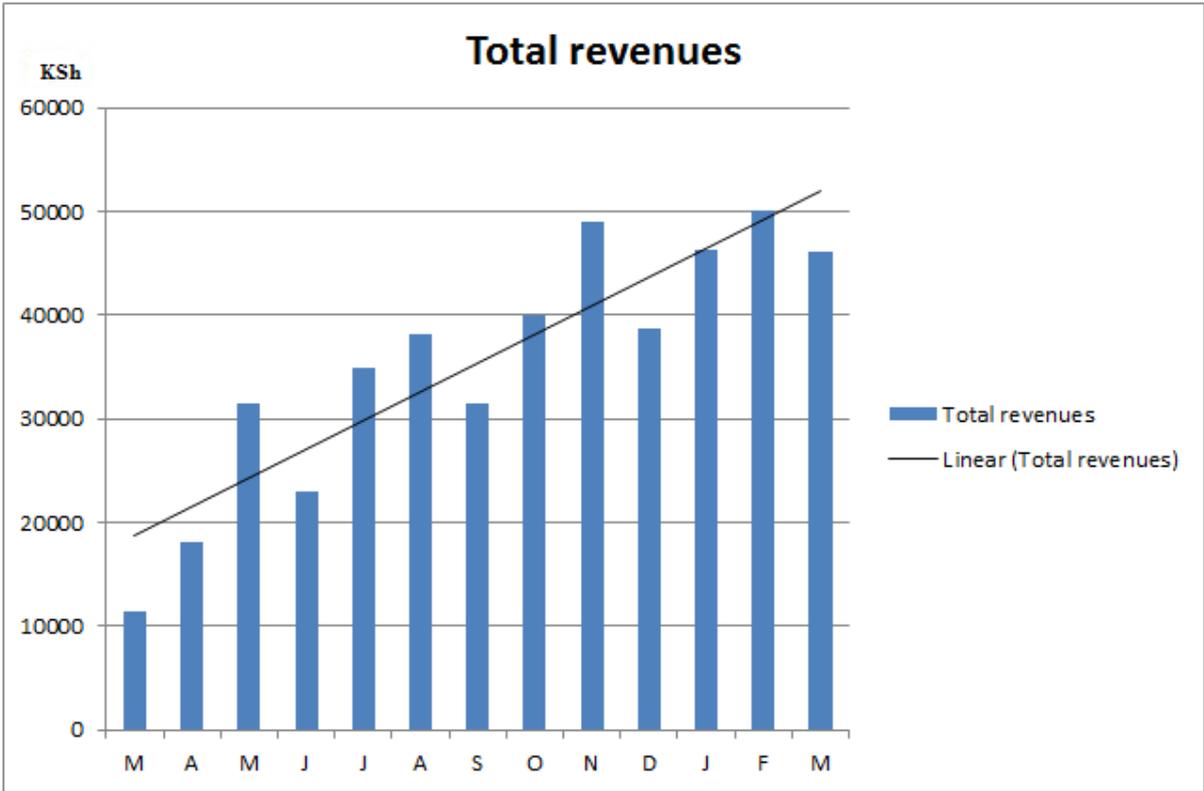


Figure 13: Total revenues generated at Ikisaya Energy Centre; March 20th 2012⁴⁰ – March 31st 2013, with linear trend line. Initials on X-axis indicate month of year (Source: Ikisaya Energy Centre⁴¹).

Further, the number of customers using a selection of services offered by the centre also indicates fluctuating demand:

⁴⁰ Note that the Energy Centre opened its business on March 20th 2012, so the revenues this month were accumulated between March 20th and March 31st.

⁴¹ Financial records from March 2012 to June 2012 were provided by Ikisaya Energy Centre to Lan Marie Nguyen Berg, master student at the University of Oslo, while financial records from July 2012 to March 2013 were provided by Ikisaya Energy Centre to Kirsten Ulsrud, “Solar Transitions” project leader.

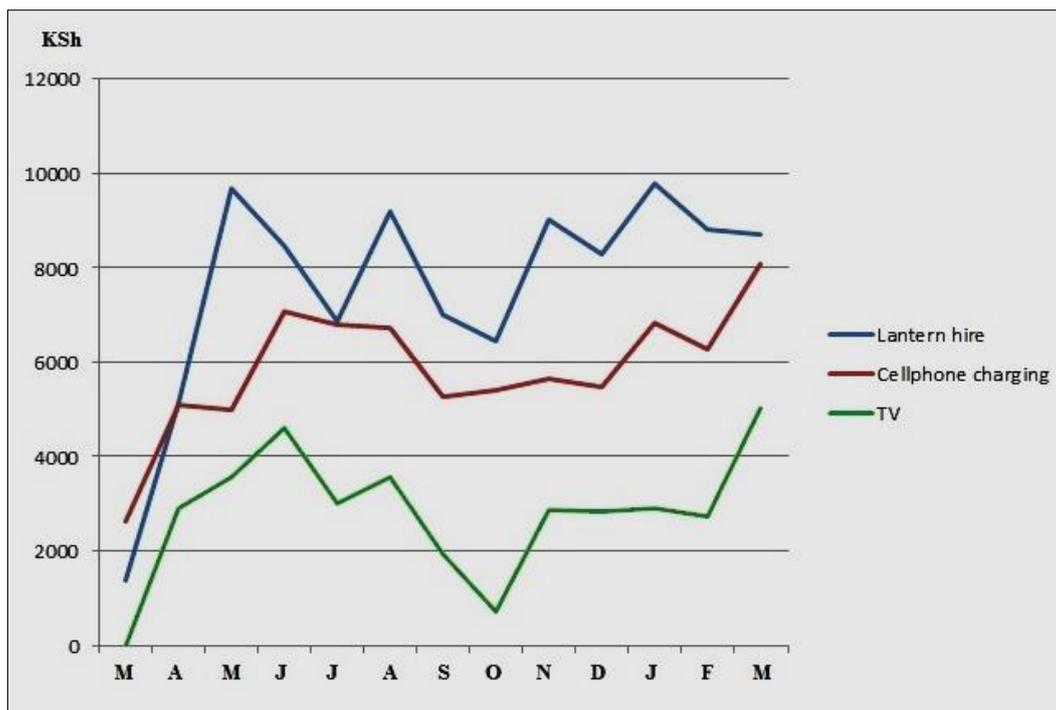


Figure 14: Revenues from lantern hire⁴², cellphone charging and TV viewing at Ikisaya Energy Centre; March 20th 2012– March 31st 2013. Initials on X-axis indicate month of year (Source: Ikisaya Energy Centre⁴³).

However, it is important to note that some of the income generated by the centre comes from outside visitors, such as myself. These numbers thus do not necessarily correctly reflect how much people in the community used the centre during this first year of operation. Nevertheless, the graphs seem to support some arguments made in the previous sections.

First of all, the use of the TV service reduced somewhat in July, perhaps as a result of the ‘dispute’ with nomadic pastoralists. Further, it seems like the use of these three services diminished quite considerably from August to October 2012. This might reflect the symbiotic effect of income poverty, unemployment and climate variability outlined in the section above. Many people in Ikisaya hardly had any money left in September/October 2012, because they, as a result of several consecutive poor rainy seasons, had received minimal income from farming the last few years. TV viewing seems to have been hit especially hard by the low purchasing power. Watching TV was by some of my informants referred to as a ‘luxury’ leisure activity that they could not prioritize to spend money on when they hardly had enough

⁴² Note that this graph only displays income from lanterns rented at Ikisaya Energy Centre, not lanterns rented at the agents in Endau, Malalani and Kalwa.

⁴³ Financial records from March 2012 to June 2012 were collected from Ikisaya Energy Centre and provided to me by Lan Marie Nguyen Berg, master student at the University of Oslo, while financial records from July 2012 to March 2013 were collected and provided to me by Kirsten Ulsrud, “Solar Transitions” project leader.

to buy food for their household. It is also possible that the ‘dissatisfaction’ in the community and associated ‘boycotts’, outlined in the previous section, might account for some of the reduction in the use of the services in September/October.

There are of course a variety of other reasons in addition to these for why people use and not use the services offered at the centre, and it is therefore difficult to assess exactly why the revenues fluctuate. Some people might rather invest in buying seeds instead of using the services; some might be busy cultivating and not have time to come to the Energy Centre; some might be sick for a period and not be able to walk all the way to the centre and so on. Nevertheless, contextual conditions and stressors do impact the Energy Centre in a variety of ways, and might challenge the viability of the centre. The Energy Centre needs to have enough revenue to cover its expenses in order to sustain itself over time.

As noted in section 6.1.1 (accessibility), the prices on the services offered at Ikisaya Energy Centre, especially portable lantern renting, seem to be too high for some members of the community, and thus excludes some from enjoying the direct benefits of the centre. However, the prices on the services cannot be reduced much if the centre is going to be viable. As explained in the background chapter, Ikisaya Energy Centre needs to generate roughly 50,000 KSh per month to cover monthly expenses, such as salaries for the staff, and save money for replacement of batteries. There is thus a dilemma between the economic sustainability of the centre and ensuring that everyone is able to access the services. Kirsten Ulsrud, project leader of Solar Transitions, said that there is a dilemma *“between how to earn enough money to be able to cover the costs and keep it going, and how to make it affordable for everybody and make it useful for everybody”* (Ulsrud 2013). Economic sustainability and independence of the centre has been one of the major goals of the Solar Transitions research project; *“Because if the local energy system cannot sustain itself, pay its own expenses over time, and do maintenance and replace batteries on its own, it becomes dependent on somebody outside the village”* (Ulsrud 2013).

For now it seems like the Energy Centre has reached a level where it generates enough revenue to cover its expenses, as well as to save for replacement of batteries. The centre might also be able to expand by itself, by purchasing more lanterns, offering new services or setting up new agents other places in the area. It thus appears like the centre will continue to offer services to people in Ikisaya well into the foreseeable future. Still, the viability of the centre is sensitive to contextual conditions and stressors, and its revenues will most likely continue to

fluctuate. It is therefore probably important for the centre to keep some savings as a buffer for periods of recession, such that monthly expenses are covered in spite of inadequate revenues. Surplus should therefore not only be spent on investing in new equipment and expansion, but some should also be kept as safeguard for downturns.

6.3 Discussion and summary: Ikisaya Energy Centre and sustainable adaptation

The first part of this chapter has discussed how Ikisaya Energy Centre impacts the vulnerability context in the community, while the second part has discussed how societal and climatic conditions and stressors in turn impact the viability of the Energy Centre. This part will build on the findings from these two previous parts to answer the main research question of this thesis; *Can local supply of solar energy contribute to sustainable adaptation to climate variability and change in rural Ikisaya, Kenya?* This main research question will be answered by discussing how the solar Energy Centre relates to the four principles of sustainable adaptation.

The *first principle of sustainable adaptation* involves recognizing and, where possible, addressing directly contextual vulnerability, including multiple stressors (Eriksen et al. 2011). A community often experiences a whole range of coinciding factors that contribute to vulnerability to climate variability and change. Addressing just one such factor might not sufficiently make people in the community able to adapt to changes and challenges in the longer term. Even though one driver of vulnerability is eliminated, other factors might continue to make people in the community vulnerable to climate variability and change. Sustainable adaptation therefore requires addressing the underlying causes of vulnerability.

As explained in this chapter, both the services offered by the Energy Centre and the centre in itself affect the vulnerability context in Ikisaya in a variety of direct and indirect ways. Although the centre obviously does not alter biophysical climatic conditions, it does moderate the adverse effects of climatic and societal drivers of vulnerability for some people.

The first way Ikisaya Energy Centre can contribute directly to reducing some individuals' vulnerability is through **reducing reliance on income from rain-fed agriculture**, by providing some with a higher income from off-farm activities, creating employment and assisting in livelihood diversification. The portable lanterns extend working hours and allow

people to do activities in the evening that are more difficult to do using kerosene lamps or the light from firewood. For example, shops and restaurants can keep open during the evening and women can make handicrafts after putting their children to sleep. Further, cellphones are used by some to facilitate business transactions, such as trading livestock and selling farm produce to middle traders. A person who wants to sell goats can call customers, and the customer can even transfer payment through M-Pesa. Cellphones are also used to receive remittances from family members working elsewhere. The portable lanterns and cellphone charging service thus contribute to increasing income for some.

Further, the restaurant and shops get more customers as a result of visitors coming to the area to visit the centre, and as a result of the staff at the Centre. Accordingly, they get higher revenues. The centre has a staff of four salaried community members, and researchers and others visiting Ikisaya offer temporary employment to some people in the community as research assistants, translators and so on. Cellphones are also used to facilitate casual labor, and the ability to charge the cellphone might thus increase the number of jobs a casual laborer gets. Those who get employment will obviously get a higher income. This additional income can be spent on agricultural adaptation and other adaptive measures, such as buying drought-resistant seeds or buying large water tanks, which will make them less vulnerable to climatic variability and change. Increased income from off-farm activities might reduce reliance on an income from farming, and thus reduce vulnerability to climatic conditions.

Another way Ikisaya Energy Centre might contribute to reducing vulnerability is through **increasing income from agricultural production**. Farmers who have a cellphone might call middle traders who can come and buy their produce or they can call someone to hear what the market price on food is elsewhere in the country. Cellphones might thus improve trade conditions. This could increase the income farmers get from selling their produce.

Further, the services offered by the Energy Centre might **reduce expenses** for some people. Those who normally spend more than 280Ksh will save on using the portable lantern instead. However, many people cannot even afford to buy kerosene regularly, and using the portable lantern would increase their expenses on light. Thus, if a household uses kerosene lamps for approximately the same number of hours per month as when using portable lanterns, they will most likely save money on using the lantern instead. Those who can afford to buy solar home systems at the centre (solar panels with bulbs and/or cellphone charging equipment) will save money on kerosene in the long run. Some of my informants said they spent less money on

buying alcohol after the Energy Centre opened, as they now could go there to watch TV instead of drinking. TV viewing might thus replace alcohol consumption as a leisure activity for men. Finally, having access to all these services in Ikisaya might reduce expenses on transportation to other places to access the same services. For example, before the Energy Centre opened, people in Ikisaya had to travel to Endau (approx. 10km from Ikisaya market), Zombe (approx. 25km) or Kitui (approx. 45km) to photocopy documents. Travelling to these places by motorbike or bus is quite costly. The expenses people save could thus be spent on measures that reduce their vulnerability to climate variability and change.

Finally, the Energy Centre and its services might allow people to save time and accordingly have **more time available for income-generating activities**. As mentioned above, before the Energy Centre opened people had to travel long distances to access the same services. The centre thus reduces the time spent on accessing services such as photocopying. The portable lanterns also allow people to do activities in the evening, and perhaps do these activities faster. Cellphones reduce time spent on communicating with others, as people do not have to travel in person to talk to someone. The time people save can thus be used for doing other income-generating activities, such as cultivating the agricultural plot or doing casual labor.

In addition to these direct ways the Energy Centre might contribute to reducing vulnerability, this chapter has also identified some *indirect* linkages. First of all, the lanterns assist schoolchildren in doing homework in the evening, and the primary school uses solar lamps to offer evening preps, or tutorial classes. The school also occasionally rent the TV room to show education films to the pupils. The centre thus in various ways might improve **education** in the village, which in turn might improve children's chances of getting salaried employment in the future. Salaried employment reduces reliance on climate-sensitive livelihoods, and can lead to remittances to relatives.

Secondly, the TV at the Energy Centre disseminates **news and weather forecasts**, which could be useful for farmers who can plan agricultural activities according to the forecasts. For example, if the meteorologists predict that the rainy season might be poor, they might choose to plant drought-resistant seeds. This could perhaps contribute to reducing harvest failures. Thirdly, increased **political awareness** about Ikisaya could perhaps lead to allocations towards development and infrastructural improvements. Fourthly, the services offered at the Energy Centre might have **health benefits**. Health is important for vulnerability, as an ill person might be unable to do income-generating activities. Portable lanterns are safer to

health than using kerosene lamps or firewood for light. The lanterns reduce indoor pollution, and kerosene-related fires and accidents. Lanterns can also increase security for especially women and children, and prevent them from being bitten by a snake or scorpion. Cellphones can also be used to call for help during acute illness or injuries.

In summary, the Energy Centre could possibly increase adaptive capacity for some. Those who can afford to use the services offered at the centre might use the services to get a higher off-farm and on-farm income and they might reduce expenses. This could increase their ability to invest in adaptive measures. However, as discussed in section 6.1.1, not everyone in the community of Ikisaya is able to access the services at the centre. Yet, those who are not able to afford using the services themselves could benefit indirectly.

I would thus say that the Energy Centre addresses some of the stressors and conditions that contribute to vulnerability in Ikisaya, but not all. However, most of the drivers of vulnerability cannot be solved by local supply of electricity alone. Greater transformations are needed. It would not be possible for such a project to address and eliminate all drivers of vulnerability.

The *second principle of sustainable adaptation* stresses the importance of acknowledging that different interests and value conflicts might affect adaptation outcomes. It is therefore important to be aware of such social and cultural dynamics, identify how they may influence adaptation outcomes and strive to involve vulnerable and marginalized groups in the process to avoid further marginalization (Eriksen et al. 2011). This chapter has outlined how underlying social and cultural dynamics have in a way manifested themselves as a result of the Ikisaya Energy Centre project, and how these dynamics have challenged the viability of the centre. The Solar Transitions research team did extensive research before and after establishment of the centre to investigate contextual conditions, and was aware of social and cultural dynamics. They therefore ensured the involvement of women in the process, and have tried to involve marginalized people in the process by for example demanding democratic elections within the CBO and maintaining that there should be two representatives from each of the six sub-villages in Ikisaya in the board (Winther 2013). However, the problem of democratic elections might be that minority groups have less influence than the majority. As there are three large clans in the community, these might end up being over-represented in the board of the CBO.

The *third principle of sustainable adaptation* asserts the need for integrating local knowledge into the adaptation process (Eriksen et al. 2011). An adaptation process should not only be based on ‘scientific knowledge’ about climate change, but should integrate local knowledge about climatic conditions in the process. Adaptation should thus be context-specific; a good adaptation strategy might be suitable for one context, while unsuitable for other contexts because of local conditions. As mentioned previously, the process of establishing Ikisaya Energy Centre has been iterative. The centre has been developed in a partnership between the Solar Transitions research team and the local community. The views, knowledge, experiences and interests of the local community have been pivotal in the design and operation of the centre. The research team did not want to impose a certain model of local electricity supply on a community, but they wanted to develop the model together with the community to fit the needs of people appropriately (Ulsrud 2013). For example, the research team investigated what services people in the community wanted and needed, as they did not want to develop a model that provided services the researchers themselves thought would be useful for people. Thus, local knowledge has been integrated into the process of establishing and operating Ikisaya Energy Centre.

Local capacity building has also been an emphasis of the Ikisaya Energy Centre project, and the local staff at the centre has received technical, administrative and financial training. They were trained by members of the Solar Transitions research group on the basics of the solar PV system, technical overview of the centre, processes and procedures, book keeping, economic/financial overview, promotion and marketing. The IT clerk was also given training in computer basics (Ulsrud 2012). The Energy Centre project has thus increased local technical and financial knowledge.

The *fourth principle of sustainable adaptation* focuses on the importance of recognizing interactions between local and global processes, as these can create both positive and negative feedbacks (Eriksen et al. 2011). For example, local adaptation measures that lead to increased emissions of greenhouse-gases (GHG) will further exacerbate global warming and associated climatic changes. Local adaptation might thus have negative feedbacks as a result of interaction between local and global processes. Adaptation measures should therefore avoid leading a community on an environmentally unsustainable development pathway. The Energy Centre in Ikisaya uses renewable energy, solar PV, to generate electricity. The centre does accordingly not lead to direct emissions of GHG. There are however some ‘upstream’ GHG emissions related to the production and construction of the solar PV equipment, but these are

negligible compared to fossil fuel based electrification. For example, a life-cycle analysis (LCA) of electrification technologies found that solar PV emits only 90 gCO₂eq per kWh, while coal emits 1004 gCO₂eq per kWh (Yadoo & Cruickshank 2012). Thus, the Energy Centre does not exacerbate global warming in any significant way. The Energy Centre has not had any negative impacts on the local environment either.

Adaptation to climate variability and change should, according to the concept of sustainable adaptation, contribute to socially and environmentally sustainable development pathways (Eriksen et al. 2011). The solar Energy Centre in Ikisaya does seem to contribute to leading the community on a development pathway that is environmentally sustainable. The issue of social sustainability is more complex. As discussed in this chapter, not everyone in the community is able to access the services, and do not benefit as much from the centre as those who can. The benefits of the centre are thus not distributed equally in the village. It is therefore possible that the Energy Centre might contribute to increasing socio-economic inequality.

In addition to the benefits and effects of the Energy Centre and its services that I have outlined in this chapter, it is important to emphasize that the centre has had a number of other benefits to well-being that do not necessarily contribute to adaptation to climate variability and change. Yet, they are important for well-being and comfortable living-conditions. For example, some of my female informants said the bright light from the solar lanterns improved the taste of food, and reduced the risk of putting too much salt or spices in it. This is not only important for the general pleasure of enjoying nice food, which is especially important during the dry season when the food is scarce, but a woman's cooking-abilities also seem to be important for their social status both within the household and within the community. An example of this was the wife in the family I was living with in Ikisaya. She was 'famous' in the village for her delicious food, and some other villagers I met told me I was fortunate to be staying with this woman because of her amazing food (I do agree that she made the best chapatti, githeri, tea and porridge I have ever tasted). Her identity thus seemed to be very much associated with her great cooking skills.

One of my male informants also mentioned that a benefit of the portable lantern is that; "*I can take a bath in the evening and go to bed fresh and clean!*" As the climate in Ikisaya is very hot, taking a bath before going to bed does increase comfort. Another benefit identified by my informants was related to improved leisure time and entertainment. For example, some of the

men I talked to said the ability to watch a movie every once in a while enhanced their well-being. A man I talked to said that watching Nigerian movies at the Energy Centre made him forget his problems and the hardship he was facing, especially during drought. He could watch the movie and escape from his struggles, even if just for a while. A final benefit I would like to mention, is that some of my female informants said they could call their children who lived elsewhere and hear how they were doing. One informant had a daughter that was living in Germany, and she said that it was wonderful to be able to hear her daughters' voice when she was missing her.

Accordingly, having access to electricity improves well-being in numerous ways. Focusing only on the productive aspects of electricity and its potentials for economic growth, as was previously the primary objective of rural electrification programs (Cabraal et al. 2005), neglects other positive benefits of rural electrification that do not necessarily improve incomes, but are still important for human well-being and development.

Chapter 7: Conclusion

The objective of this thesis has been to investigate if local supply of electricity from a decentralized solar energy centre can contribute to leading the village of Ikisaya, Kenya, on a development pathway that is socially and environmentally sustainable. The overall research question has been; *Can local supply of solar energy contribute to sustainable adaptation to climate variability and change in rural Ikisaya, Kenya?* This issue has been explored through using a qualitative case study approach. A theoretical framework based on the concept of sustainable adaptation has been employed to guide the research process and analyze empirical findings.

Addressing the vulnerability context, including the drivers of vulnerability, conditions shaping vulnerability, and people's responses to multiple stressors, is an essential element of sustainable adaptation (Eriksen et al. 2011). The first part of the analysis in this thesis (chapter 5) has therefore examined the vulnerability context in Ikisaya by addressing the following sub-question; *How do climatic and societal factors, and people's responses to these, contribute to contextual vulnerability in Ikisaya?* Climatic and societal factors, also referred to as 'drivers of vulnerability', were found to be interlinked in a variety of ways and are to some degree mutually reinforcing. How people respond to these, by coping with short-term challenges or adapting to changes in the longer term, are also inextricably linked with the drivers of vulnerability. Hence, the drivers of vulnerability and responses to these shape the vulnerability context in Ikisaya.

The thesis found that the main climatic factors contributing to vulnerability in Ikisaya is generally low levels of precipitation, high inter-annual rainfall variability, erratic precipitation during the rainy seasons, recurrent droughts and occasional heavy rainfall events. Total annual amounts of rainfall in the area also appear to have decreased the last five decades. The findings also reinforced that rainfall has become more erratic and localized, and that temperatures have increased. These climatic factors lead to frequent harvest failures and exacerbate water scarcity, both of which have implications for vulnerability and adaptive capacity.

Economic, political and socio-cultural factors, as well as conflicts and insecurity, was identified as the main societal drivers of vulnerability in Ikisaya. Income poverty is prevalent

in the area. Very few people have formal employment or a stable source of income, and the majority relies on climate-sensitive livelihoods, such as farming and livestock-keeping. Political marginalization also contributes to vulnerability, as the infrastructure in the village is poorly developed and public services, such as healthcare services, are practically non-existent. Furthermore, disputes and tensions between the settled population and nomadic pastoralists occasionally lead to violent clashes and raids. The dispute also contributes to insecurity, restrict seasonal movement of livestock as well as tensions within the settled population in the area. Socio-cultural dynamics, related to the clan system, socio-economic inequality and gender relations, is also an important aspect of contextual vulnerability, and contributes somewhat to differential vulnerability. Clan affiliation and socio-economic status seem to influence local politics and decision-making processes, perhaps leading to marginalizing of some groups' interests. Gender relations also contribute to unequal vulnerability. Ikisaya is a patriarchal society, where access to resources, distribution of labor and norms for social behavior are closely linked to culturally and religiously ascribed gender roles. Women generally have less access to resources, such as land, and their labor responsibilities are primarily focused on unproductive activities. Women accordingly have less financial freedom than men.

This thesis has further revealed that people in Ikisaya employ a variety of strategies to moderate the adverse effects of climatic and societal drivers of vulnerability. The short-term coping strategies focus on livelihood diversification, drawing on social networks, engaging in group activities or receiving relief food or seeds from the government or church. These coping strategies generally provide people with a marginal and instable income. Some people also perform 'illegal' activities to get food or income. These are not only risky in terms of law enforcement, but also in terms of safety and health. These illegal activities can therefore potentially put further burdens on an already strained household, and hence increase vulnerability. Some of these illegal activities also negatively effects the environment and biodiversity, and can thus reduce access to important resources in the longer term. Many of the coping strategies are therefore not environmentally or socially sustainable, and could potentially exacerbate vulnerability.

Some longer-term adaptive measures employed by people in Ikisaya have also been identified in this thesis. These aim at enhancing agricultural productivity or securing access to water in the face of climatic variability and change. These measures are however not available to everyone, due to high investment costs or manual labor demand. Those who are able to access

these adaptive measures are therefore not necessarily those who are already the most vulnerable. This contributes to increasing inequality and differential vulnerability. This thesis has accordingly revealed that climatic and societal factors, as well as people's responses to these, are inextricably linked, and together shape the vulnerability context in Ikisaya.

Findings from this thesis accentuate the need to investigate not only how multiple stressors and contextual conditions contribute to vulnerability, but also how responses to these is an integral part of the vulnerability context and may lead to differential vulnerability. Hence, not only do climatic and societal factors cause unequal vulnerability across social groups, but uneven access to coping strategies and adaptive measures can also exacerbate inequity.

The second part of the analysis in this thesis, chapter 6, investigated how solar energy can contribute to sustainable adaptation to climate variability and change. The chapter first addressed the second sub-question of this thesis; *How does the solar Energy Centre influence the vulnerability context in Ikisaya, and how do climatic and societal factors in turn affect the viability of the solar Energy Centre?*

This chapter showed that the services offered by the Energy Centre, and the centre in itself, influence the vulnerability context in a variety of ways. The centre obviously does not alter climatic conditions, but they contribute somewhat to moderating the adverse effects of climatic and societal factors. However, not everyone in the community is able to access the services, and the Energy Centre therefore does not benefit them directly. The poorest, and those living the furthest from the Energy Centre or the agents, seem to benefit the least. Yet, those who cannot access the services themselves might benefit indirectly in the longer term as a result of general community development.

Some of the findings of this research correspond to findings from previous research, but some issues revealed in this thesis contribute to new understandings of the relationship between rural electrification, development and sustainable adaptation. As outlined in the theoretical chapter, previous research has found rural electrification and decentralized renewable energy to have positive benefits on livelihoods, poverty, education, health and gender equality (see section 3.3). This research has also found the local supply of electricity in Ikisaya to have positive implications for these issues. This research has however revealed some additional benefits of local supply of electricity that was not presented in the literature reviewed for this thesis.

First, this research has found that having access to electricity can save time in a number of ways not mentioned in the previous research. For example, using cellphones for communication save time spent on travelling in person to those you need to communicate with. The bright light from the solar lanterns also help people do some activities faster, such as cooking. This research also found that people save time on not having to travel as far to access services such as photocopying. The time saved can be spent on doing important on-farm and off-farm activities, and can therefore increase coping and adaptive capacity. Secondly, the services offered at the centre has supported important coping strategies, such as enhancing access to casual employment, remittances, trade and business. Thirdly, the Energy Centre in Ikisaya seems to contribute to reducing alcoholism, as men chose to spend money on watching TV instead of drinking. Fourthly, supply of kerosene to Ikisaya is restricted during the rainy season, due to impassable roads, and the solar lanterns are thus alternative sources of light when there is no kerosene. Solar lanterns are therefore more reliable than kerosene.

Climatic and societal factors were in turn found to have an effect on the viability of the centre. Climatic variability and droughts coincide with economic factors, and lead to fluctuating purchasing power and demand for the services. Conflict and insecurity can also contribute to reducing use of the services. The Energy Centre needs to generate enough revenue per month to cover expenses and save for replacing batteries. Therefore, low and fluctuating revenues could potentially challenge the ability to pay salaries for the staff or replace batteries, thus undermine the financial sustainability of the centre. Socio-cultural dynamics are also important for the long-term viability of the centre. This thesis has furthermore emphasized that there are dilemmas between financial viability of decentralized rural electrification projects and accessibility for all.

The study shows the importance of studying relations as dynamic, rather than treating them as uni-directional. In particular, an intervention, like the Energy Centre, has an effect on the local vulnerability context. However, its effect on sustainable adaptation cannot be understood unless you also study how the context, including climatic factors themselves, influence the intervention. An intervention does not operate in isolation from the local context, it becomes part of it, including political and social relations. Efforts to support sustainable adaptation must be understood in this manner.

Chapter 6 also addressed the main research question of this thesis; *Can local supply of solar energy contribute to sustainable adaptation to climate variability and change in rural Ikisaya, Kenya?* The chapter answered this question by discussing how the Energy Centre relates to the four principles of sustainable adaptation (Eriksen et al. 2011). The first principle states that adaptation needs to recognize, and where possible, address directly contextual vulnerability. The Energy Centre in Ikisaya does address some of the factors that contribute to vulnerability, and contributes to reducing vulnerability for some people. Yet, many of the challenges the community in general, and individuals in particular, are facing, cannot be solved by local supply of solar energy alone. It would therefore not be possible for a project such as this one to address and alleviate all causes of vulnerability. Greater transformations are needed (O'Brien 2011).

The second principle of sustainable adaptation involves acknowledging that different interests might affect the outcome of adaptation. Adaptation efforts therefore need to be sensitive to socio-cultural dynamics and strive to avoid marginalizing groups in the process. The Solar Transitions research project has involved the community in the process of establishing Ikisaya Energy Centre. Women have also been explicitly invited to participate in the process. The centre thus seems to have involved also marginalized groups in the process. The third principle of sustainable adaptation involves integrating local knowledge into the adaptation process. This was achieved in Ikisaya through inviting the local community to participate in the design of the Energy Centre, and by building local capacity. As the Energy Centre is managed and operated by the local community, the centre is also flexible to local conditions. The fourth principle involves recognizing local and global feedbacks. The Energy Centre in Ikisaya uses Solar PV technology to generate electricity, and therefore does not contribute to increasing concentrations of greenhouse gases in the atmosphere. The centre does not lead to environmental degradation locally either.

The decentralized solar Energy Centre in Ikisaya hence contributes to leading the community on a development pathway that is environmentally sustainable. The issue of social sustainability is however somewhat more complex. As discussed in this chapter, not everyone in the community is able to access the services, and do not benefit as much from the centre as those who can. Hence, the benefits of the centre are not distributed equally in the village, and the Energy Centre could potentially contribute to increasing socio-economic inequality. Although the Energy Centre does not reduce vulnerability for everyone, the centre does not seem to *increase* vulnerability either. I would therefore argue that the centre contributes to

social justice as well, and thus contribute to sustainable adaptation to climate variability and change.

Using the concept of sustainable adaptation as basis for the theoretical framework in this research process has been useful, as it has allowed for investigating implications for social and environmental sustainability of local supply of electricity. Employing this theoretical framework has contributed to new understandings about decentralized renewable energy and the adaptation-mitigation nexus. Furthermore, using the socio-technical systems approach to complement the theoretical framework has been helpful. This approach emphasize that the viability of technological interventions, such as the Energy Centre in Ikisaya, is not only dependent on the technical configurations in themselves, but is also influenced by social and institutional settings. In order to study the effects of rural electrification programs, it is therefore important to not only focus on the technical attributes of the system, but also on the social aspects.

In terms of policy implications, this case study suggests that adaption interventions need to be sensitive and flexible to local climatic and societal conditions, in order to contribute to both social and environmental sustainable development pathways. It is important to recognize that although decentralized renewable energy has the potential to reconcile concerns for development, adaptation and mitigation of climate change, not all decentralized renewable energy projects necessarily contribute to environmental and social sustainability.

Reference list

- Acker, R. H. & Kammen, D. M. (1996). The quiet (energy) revolution: Analysing the dissemination of photovoltaic power systems in Kenya. *Energy Policy*, 24 (1): 81-111.
- Adams, W. M. (2009). *Green Development: Environment and Sustainability in a Developing World*. London: Routledge. 449 pp.
- Adger, W. N. (1999). Social Vulnerability to Climate Change and Extremes in Coastal Vietnam. *World Development*, 27 (2): 249-269.
- Adger, W. N., Huq, S., Brown, K., Conway, D. & Hulme, M. (2003). Adaptation to climate change in the developing world. *Progress in Development Studies*, 3 (3): 179-195.
- Adger, W. N., Eakin, H. & Winkels, A. (2009). Nested and teleconnected vulnerabilities to environmental change. *Frontiers in Ecology and the Environment*, 7 (3): 150-157.
- Ahlborg, H. & Hammar, L. (2012). Drivers and barriers to rural electrification in Tanzania and Mozambique – Grid-extension, off-grid, and renewable energy technologies. *Renewable Energy* xxx (2012): 1-8.
- Alasuutari, P., Bickman, L. & Brannen, J. (2008). Social Research in Changing Social Conditions. In Alasuutari, P., Bickman, L. & Brannen, J. (eds) *The SAGE Handbook of Social Research Methods*, pp. 1-11. London: SAGE.
- Ang, F. & Van Passel, S. (2012). Beyond the Environmentalist's Paradox and the Debate on Weak versus Strong Sustainability. *Bioscience*, 62 (3): 251-259.
- Armstrong, K. (2008). Ethnography and Audience. In Alasuutari, P., Bickman, L. & Brannen, J. (eds) *The SAGE Handbook of Social Research Methods*, pp. 54-67. London: SAGE.
- Arvizu, D., Balaya, P., Cabeza, L., Hollands, T., Jäger-Waldau, A., Kondo, M., Konseibo, C., Meleshko, V., Stein, W., Tamaura, Y., et al. (2011). Direct Solar Energy. In Edenhofer, O., Pichs-Madruga, R., Sokona, Y., Seyboth, K., Matschoss, P., Kadner, S., Zwickel, T., Eickemeier, P., Hansen, G., Schlömer, S., et al. (eds) *IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation*. Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press.
- Banerjee, S. B. (2003). Who sustains whose development? Sustainable development and the reinvention of nature. *Organization Studies*, 24 (1): 143-180.
- Banik, D. (2006). Introduction. In Banik, D. (ed.) *Poverty, Politics and Development: Interdisciplinary Perspectives*, pp. 9-27. Bergen: Fagbokforlaget.
- Barker, T., Bashmakov, I., Bernstein, L., Bogner, J. E., Bosch, P. R., Dave, R., Davidson, O. R., Fischer, B. S., Gupta, S., Halsnæs, K., et al. (2007). Technical Summary. In Metz, B., Davidson, O. R., Bosch, P. R., Dave, R. & Meyer, L. A. (eds) *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, UK and New York, USA: Cambridge University Press.
- Barnett, B. J., Barrett, C. B. & Skees, J. R. (2008). Poverty Traps and Index-Based Risk Transfer Products. *World Development*, 36 (10): 1766-1785.
- Barnett, J. (2008). The Effect of Aid on Capacity to Adapt to Climate Change: Insights from Niue. *Political Science*, 60 (1): 31-45.

- Barnett, J. & O'Neill, S. (2010). Maladaptation. *Global Environmental Change-Human and Policy Dimensions*, 20 (2): 211-213.
- Basher, R. & Briceño, S. (2005). Climate and disaster risk reduction in Africa. In Low, P. S. (ed.) *Climate Change and Africa*, pp. 271-283. Cambridge: Cambridge University Press.
- Baxter, J. (2010). Case Studies in Qualitative Research. In *Qualitative Research Methods in Human Geography*, pp. 81-97. Oxford: Oxford University Press.
- Birol, F. & Brew-Hammond, A. (2012). *Sustainable Energy for All - Technical Report of Task Force 1 - in Support of the Objective to Achieve Universal Access to Modern Energy Services by 2030: The Secretary General's High-level Group on Sustainable Energy for All*.
- Bjurström, A. & Polk, M. (2011). Physical and Economic Bias in Climate Change Research: a Scientometric Study of IPCC Third Assessment Report. *Climatic Change*, 108 (1-2): 1-22.
- Blewitt, J. (2008). *Understanding sustainable development*. London: Earthscan. 288 pp.
- Bogdan, R. & Biklen, S. K. (2007). *Qualitative research for education : an introduction to theory and methods*. Boston, Mass.: Pearson A & B. 304 pp.
- Boko, M., Niang, I., Nyong, A., Vogel, C., Githeko, A., Medany, M., Osman-Elasha, B., Tabo, R. & Yanda, P. (2007). Africa. In Parry, M. L., Canziani, O. F., Palutikof, J. P., van der Linden, P. J. & Hanson, C. E. (eds) *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, pp. 433-467. Cambridge, UK: Cambridge University Press.
- Borchgrevink, A. (2006). Dingos, Gringos and Other Animals in the Field of Development: Aid and NGOs. In Banik, D. (ed.) *Poverty, Politics and Development: Interdisciplinary Perspectives*, pp. 250-272. Bergen: Fagbokforlaget.
- Brooks, N. (2003). *Vulnerability, risk and adaptation: a conceptual framework*: Tyndall Centre Working Paper 38.
- Brooks, N., Grist, N. & Brown, K. (2009). Development Futures in the Context of Climate Change: Challenging the Present and Learning from the Past. *Development Policy Review*, 27 (6): 741-765.
- Brown, K. (2011). Sustainable adaptation: An oxymoron? *Climate and Development*, 3 (1): 21-31.
- Bryman, A. (2008a). The End of the Paradigm Wars? In Alasuutari, P., Bickman, L. & Brannen, J. (eds) *The SAGE Handbook of Social Research Methods*, pp. 13-25. London: SAGE.
- Bryman, A. (2008b). *Social Research Methods*. Oxford: Oxford University Press. 748 pp.
- Bull, B. (2006). Development Theory Revisited. In Banik, D. (ed.) *Poverty, Politics and Development: Interdisciplinary Perspectives*, pp. 28-52. Bergen: Fagbokforlaget.
- Bull, B. & Bøås, M. (2010). Introduction: Introducing International Development. In Bøås, M. & Bull, B. (eds) vol. 1 *International Development*, pp. xix-xliv. London: Sage.

- Burton, I., Huq, S., Lim, B., Pilifosova, O. & Schipper, E. L. (2002). From impacts assessment to adaptation priorities: the shaping of adaptation policy. *Climate Policy*, 2 (2-3): 145-159.
- Bøås, M. & Dunn, K. (2013). *Politics of Origin in Africa: Autochthony, Citizenship and Conflict*. London: Zed Books. 149 pp.
- Cabraal, R. A., Barnes, D. F. & Agarwal, S. G. (2005). Productive Uses of Energy for Rural Development. *Annual Review of Environment and Resources*, 30: 117-144.
- Cambridge Dictionaries Online. (2013). *Xenophobia: Definition* Available at: <http://dictionary.cambridge.org/dictionary/british/xenophobia> (accessed: 08.03.2013).
- Carter, T., Parry, M., Nishioka, S. & Harasawa, H. (1996). Technical Guidelines for Assessing Climate Change Impacts and Adaptations. In Watson, R. T., Zinyowera, M. C. & Moss, R. H. (eds) *Climate change 1995: Impacts, Adaptations and Mitigation of Climate Change: Scientific-technical Analyses Contribution of Working Group II to the Second Assessment of the Intergovernmental Panel on Climate Change*, pp. 823-834. Cambridge: Cambridge University Press.
- Chakrabarti, S. & Chakrabarti, S. (2002). Rural electrification programme with solar energy in remote region—a case study in an island. *Energy Policy*, 30 (1): 33-42.
- Chambers, R. & Conway, G. R. (1992). *Sustainable rural livelihoods: practical concepts for the 21st century*. Sussex: Institute of Development Studies.
- Chambers, R. (1995). Poverty and livelihoods - Whose reality counts? *Environment and Urbanization*, 7 (1): 173-204.
- Charlton, R. (1995). NGOs, Politics, Projects and Probity - A Policy Implementation Perspective. *Third World Quarterly*, 16 (2): 237-255.
- Chasek, P. S., Downie, D. L. & Brown, J. W. (2010). *Global Environmental Politics*. Boulder, Colorado, USA: Westview Press. 473 pp.
- Christensen, J. H., Hewitson, B., Busuioc, A., Chen, A., Gao, X., Held, I., Jones, R., Kolli, R. K., Kwon, W.-T., Laprise, R., et al. (2007). Regional Climate Projections. In Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor & Miller, H. L. (eds) *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, United Kingdom and New York, NY, USA.: Cambridge University Press.
- Cloke, P. J., Cook, I., Crang, P., Goodwin, M., Painter, J. & Philo, C. (2004). *Practising Human Geography*. London: Sage. 416 pp.
- Coghlan, A. (2011). La Niña behind east Africa's drought. *New Scientist*, 211 (2820): 12.
- Cohen, S., Demeritt, D., Robinson, J. & Rothman, D. (1998). Climate change and sustainable development: towards dialogue. *Global Environmental Change*, 8 (4): 341-371.
- Davies, S. (2009). Are Coping Strategies a Cop-Out? In Schipper, E. L. F. & Burton, I. (eds) *The Earthscan Reader on Adaptation to Climate Change*, pp. 99-116. London: Earthscan.
- DFID. (2002). *Energy for the poor: Underpinning the Millennium Development Goals*. UK: Department for International Development.

- Dowling, R. (2010). Power, Subjectivity and Ethics in Qualitative Research. In *Qualitative Research Methods in Human Geography*, pp. 26-39. Oxford: Oxford University Press.
- Easterly, W. (2009). Can the West Save Africa? *Journal of Economic Literature*, 47 (2): 373-447.
- Edenhofer, O., Madruga, R. P., Sokona, Y., Seyboth, K., Kadner, S., Zwickel, T., Eickemeier, P., Hansen, G., Schlömer, S., von Stechow, C., et al. (2012). *Renewable Energy Sources and Climate Change Mitigation: Special Report of the Intergovernmental Panel on Climate Change*. New York, USA: Cambridge University Press.
- Eriksen, S. (2005). The role of indigenous plants in household adaptation to climate change: the Kenyan experience. In Low, P. S. (ed.) *Climate Change and Africa*, pp. 248-259. Cambridge: Cambridge University Press.
- Eriksen, S., Klein, R. J. T., Ulsrud, K., Næss, L. O. & O'Brien, K. (2007). *Climate change adaptation and poverty reduction: Key interactions and critical measures*. Report prepared for the Norwegian Agency for Development Cooperation (NORAD). GECHS Report, vol. 2007:1. Oslo: University of Oslo. 42 pp.
- Eriksen, S. & Lind, J. (2009). Adaptation as a political process: adjusting to drought and conflict in Kenya's drylands. *Environmental Management*, 43 (5): 817-35.
- 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., et al. (2011). When not every response to climate change is a good one: Identifying principles for sustainable adaptation. *Climate and Development*, 3 (1): 7-20.
- Eriksen, S. H., Brown, K. & Kelly, P. M. (2005). The dynamics of vulnerability: locating coping strategies in Kenya and Tanzania. *Geographical Journal*, 171 (4): 287-305.
- Eriksen, S. H. & O'Brien, K. (2007). Vulnerability, poverty and the need for sustainable adaptation measures. *Climate Policy*, 7 (4): 337-352.
- Eriksen, S. H., O'Brien, K. & Rosentrater, L. (2008). *Climate change in eastern and southern Africa: impacts, vulnerability and adaptation*. GECHS report, vol. 2008:2. Oslo: GECHS International Project Office. 26 s. pp.
- Eriksen, S. H. & Marin, A. (2011). *Pastoral pathways: Climate change adaptation lessons from Ethiopia*. Oslo: Development Fund. 51 pp.
- Fisher, C. B. & Anushko, A. E. (2008). Research Ethics in Social Science. In Alasuutari, P., Bickman, L. & Brannen, J. (eds) *The SAGE Handbook of Social Research Methods*, pp. 95-109. London: SAGE.
- Gachathi, F. N. & Eriksen, S. (2011). Gums and resins: The potential for supporting sustainable adaptation in Kenya's drylands. *Climate and Development*, 3 (1): 59-70.
- Gathui, T. w., Mugo, F., Ngugi, W., Wanjiru, H. & Kamau, S. (2011). *The Kenya Charcoal Policy Handbook: Current Regulations for a Sustainable Charcoal Sector*. Nairobi: Kenya: Prepared for PISCES by Practical Action Consulting East Africa.
- George, A. L. & Bennett, A. (2005). *Case Studies and Theory Development in the Social Sciences*. Cambridge, Massachusetts: MIT Press. 331 pp.
- Gettleman, J. (2012). At Least 15 Die in Kenya Church Attacks. *The New York Times*. Available at: <http://www.nytimes.com/2012/07/02/world/africa/at-least-15-dead-in-attacks-on-2-churches-in-kenya.html> (accessed: 08.03.13).

- Gibson, C. C., Andersson, K., Ostrom, E. & Shivakumar, S. (2005). *The Samaritan's Dilemma: the Political Economy of Development Aid*. Oxford: Oxford University Press. 264 pp.
- Gichungi, H. (2013). *The Solar Energy Efforts of the Government of Kenya - Main Activities and Challenges*. Lecture given at MILEN Mini-Conference; "Development and Implementation of Technology, a Focus on Solar Energy", 12.04.2013, Oslo: Norway.
- Gippner, O., Dhakal, S. & Sovacool, B. K. (2013). Microhydro electrification and climate change adaptation in Nepal: socioeconomic lessons from the Rural Energy Development Program (REDP). *Mitigation and Adaptation Strategies for Global Change*, 18 (4): 407-427.
- Glantz, M. H. (1987). Drought in Africa. *Scientific American*, 256 (6): 34-40.
- Goddard, L. & Graham, N. E. (1999). Importance of the Indian Ocean for simulating rainfall anomalies over eastern and southern Africa. *Journal of Geophysical Research: Atmospheres*, 104 (D16): 19099-19116.
- Hulme, M., Doherty, R., Ngara, T., New, M. & Lister, D. (2001). African climate change: 1900-2100. *Climate Research*, 17 (2): 145-168.
- Hussein, M. A. (2011). Climate Change Impacts on East Africa. In Filho, W. L. (ed.) *Climate Change Management, Economic, Social and Political Elements of Climate Change*, pp. 589-601. Berlin: Springer-Verlag Berlin.
- IEA. (2012). *World Energy Outlook 2012*: International Energy Agency, OECD Publishing.
- IPCC. (2007a). Annex I: Glossary. In Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor & Miller, H. L. (eds) *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, pp. 941-954. Cambridge, United Kingdom and New York, NY, USA.: Cambridge University Press.
- IPCC. (2007b). Summary for Policymakers. In Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor & Miller, H. L. (eds) *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, pp. 1-18. Cambridge, United Kingdom and New York, NY, USA.: Cambridge University Press.
- IPCC. (2012). *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation: Special Report of the Intergovernmental Panel on Climate Change*. Field, C. B., Barros, V., Stocker, T. F., Qin, D., Dokken, D. J., Ebi, K. L., Mastrandrea, M. D., Mach, K. J., Plattner, G.-K., Allen, S. K., et al. (eds). Cambridge, UK and New York, USA: Cambridge University Press. p. 592.
- Irungu, P. (2000). *Cattle Keeping Practices of the Orma People - A Household Survey in Tana River District, Kenya*: A KETRI-ILRI Collaborative Study.
- Jacobson, A. (2007). Connective Power: Solar Electrification and Social Change in Kenya. *World Development*, 35 (1): 144-162.
- James, R. & Washington, R. (2013). Changes in African temperature and precipitation associated with degrees of global warming. *Climatic Change*, 117 (4): 859-872.
- Kapborg, I. & Berterö, C. (2002). Using an interpreter in qualitative interviews: does it threaten validity? *Nursing Inquiry*, 9 (1): 52-56.

- Kasperson, R. E., Kasperson, J. X. & Dow, K. (2001). Vulnerability, equity and global environmental change. In Kasperson, J. X. & Kasperson, R. E. (eds) *Global Environmental Risk*, pp. 247-272. Tokyo, Japan: United Nations University Press.
- Kearns, R. A. (2010). Seeing with Clarity: Undertaking Observational Research. In *Qualitative Research Methods in Human Geography*, pp. 241-258. Oxford: Oxford University Press.
- Kelly, P. M. & Adger, W. N. (2000). Theory and practice in assessing vulnerability to climate change and facilitating adaptation. *Climatic Change*, 47 (4): 325-352.
- Kenya National Bureau of Statistics. (2007). Report on well-being in Kenya - Based on Kenya Integrated Household Budget Survey - 2005/2006. Nairobi: Kenya.
- King, G., Keohane, R. O. & Verba, S. (1994). *Designing Social Inquiry: Scientific Inference in Qualitative Research*. Princeton, New Jersey, USA: Princeton University Press. 247 pp.
- Kirkby, J., O'Keefe, P. & Timberlake, L. (1995). Introduction. In Kirkby, J., O'Keefe, P. & Timberlake, L. (eds) *The Earthscan reader in sustainable development*, p. 371. London: Earthscan.
- Kirubi, C., Jacobson, A., Kammen, D. M. & Mills, A. (2009). Community-Based Electric Micro-Grids Can Contribute to Rural Development: Evidence from Kenya. *World Development*, 37 (7): 1208-1221.
- Kirubi, G. (2011). *Solar Transitions Project - Ikisaya Survey Final Report*. Nairobi: Kenya.
- Klein, R. J. T., Schipper, E. L. F. & Dessai, S. (2005). Integrating mitigation and adaptation into climate and development policy: three research questions. *Environmental Science & Policy*, 8 (6): 579-588.
- Klein, R. T., Eriksen, S. H., Næss, L., Hammill, A., Tanner, T., Robledo, C. & O'Brien, K. (2007). Portfolio screening to support the mainstreaming of adaptation to climate change into development assistance. *Climatic Change*, 84 (1): 23-44.
- Kothari, U. & Cooke, B. (2001). *Participation: the new tyranny?* London: Zed Books. 207 pp.
- Langhelle, O. (2002). Bærekraftig utvikling. In Benjaminsen, T. A. & Svarstad, H. (eds) *Samfunnsperspektiver på miljø og utvikling*, pp. 225-254. Oslo: Universitetsforlaget.
- Laufer, D. & Schäfer, M. (2011). The implementation of Solar Home Systems as a poverty reduction strategy—A case study in Sri Lanka. *Energy for Sustainable Development*, 15 (3): 330-336.
- Lind, J. & Eriksen, S. (2005). *The impacts of conflict on household coping strategies: Evidence from Turkana and Kitui Districts in Kenya*. Human Security and Climate Change - An International Workshop, Holmen Fjord Hotel, Asker, Norway. 21-23. June 2005.
- Liverman, D. M. (2001). Vulnerability to global environmental change. In Kasperson, J. X. & Kasperson, R. E. (eds) *Global Environmental Risk*, pp. 201-216. Tokyo, Japan: United Nations University Press.
- Lloyd, Cynthia B., Mensch, Barbara S. & Clark, Wesley H. (2000). The Effects of Primary School Quality on School Dropout among Kenyan Girls and Boys. *Comparative Education Review*, 44 (2): 113-147.

- Lochery, E. (2012). Rendering difference visible: The Kenyan state and its Somali citizens. *African Affairs*, 111 (445): 615-639.
- Mabry, L. (2008). Case Study in Social Research. In Alasuutari, P., Bickman, L. & Brannen, J. (eds) *The SAGE Handbook of Social Research Methods*, pp. 214-227. London: SAGE.
- Mahapatra, S. & Dasappa, S. (2012). Rural electrification: Optimising the choice between decentralised renewable energy sources and grid extension. *Energy for Sustainable Development*, 16 (2): 146-154.
- Matsaert, H., Kariuki, J. & Mude, A. (2011). Index-based livestock insurance for Kenyan pastoralists: An innovation systems perspective. *Development in Practice*, 21 (3): 343-356.
- Middleton, J. & Kershaw, G. (1965). *The central tribes of the North-Eastern Bantu : (the Kikuyu, including Embu, Meru, Mbere, Chuka, Mwimbi, Tharaka, and the Kamba of Kenya)*. London: International African Institute. 103 pp.
- Miles, M. B. & Huberman, A. M. (1994). *Qualitative Data Analysis: An Expanded Sourcebook*. Thousand Oaks, California, USA: Sage. 338 pp.
- Miller, A. N., Golding, L., Ngula, K. W., Wambua, M., Mutua, E., Kitizo, M. N., Teti, C., Booker, N., Mwithia, K. & Rubin, D. L. (2009). Couples' communication on sexual and relational issues among the Akamba in Kenya. *Ajar-African Journal of Aids Research*, 8 (1): 51-60.
- Miller, A. N., Golding, L., Ngula, K. w., Wambua, M., Mutua, E., Kitizo, M. N., Teti, C., Booker, N., Mwithia, K. & Rubin, D. L. (2009). Couples' communication on sexual and relational issues among the Akamba in Kenya. *African Journal of AIDS Research*, 8 (1): 51-60.
- Mishra, A. K. & Singh, V. P. (2010). A review of drought concepts. *Journal of Hydrology*, 391 (1-2): 202-216.
- Mondal, A. H. & Klein, D. (2011). Impacts of solar home systems on social development in rural Bangladesh. *Energy for Sustainable Development*, 15 (1): 17-20.
- Muller, E., Diab, R. D., Binedell, M. & Hounsoume, R. (2003). Health risk assessment of kerosene usage in an informal settlement in Durban, South Africa. *Atmospheric Environment*, 37 (15): 2015-2022.
- Munasinghe, M. & Swart, R. (2005). *Primer on climate change and sustainable development: facts, policy analysis, and applications*. Cambridge: Cambridge University Press. 445 pp.
- Nilssen, V. L. (2012). *Analyse i kvalitative studier: Den skrivende forskeren*. Oslo: Universitetsforlaget. 190 pp.
- Nustad, K. G. (2006). Foreign Aid and the Ideas of Development. In Banik, D. (ed.) *Poverty, Politics and Development: Interdisciplinary Perspectives*, pp. 230-249. Bergen: Fagbokforlaget.
- O'Brien, K., Eriksen, S., Schjolden, A. & Nygaard, L. (2004). *What's in a word? Conflicting interpretations of vulnerability in climate change research*. CICERO working paper, vol. 2004:04. Oslo: Cicero. 16 pp.
- 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.

- O'Brien, K. & Leichenko, R. (2007). *Human Security, Vulnerability and Sustainable Adaptation*. Human Development Report Office, Occasional paper 2007/9. UNDP, New York.
- O'Brien, K. (2011). Global environmental change II: From adaptation to deliberate transformation. *Progress in Human Geography*.
- O'Brien, K., Quinlan, T. & Ziervogel, G. (2009). Vulnerability interventions in the context of multiple stressors: lessons from the Southern Africa Vulnerability Initiative (SAVI). *Environmental Science & Policy*, 12 (1): 23-32.
- OECD. (2001). *The DAC Guidelines - Poverty Reduction*. Paris: Organisation for Economic Co-operation and Development.
- Owuor, B., Eriksen, S. & Mauta, W. (2005). Adapting to Climate Change in a Dryland Mountain Environment in Kenya. *Mountain Research and Development*, 25 (4): 310-315.
- Owuor, B., Mauta, W. & Eriksen, S. (2011). Sustainable adaptation and human security: Interactions between pastoral and agropastoral groups in dryland Kenya. *Climate and Development*, 3 (1): 42-58.
- Patt, A. G. (2009). Learning to crawl: how to use seasonal climate forecasts to build adaptive capacity. In Adger, W. N., Lorenzoni, I. & O'Brien, K. L. (eds) *Adapting to climate change: thresholds, values, governance*, pp. 79-95. Cambridge: Cambridge University Press.
- Pearsall, J. (ed.) (1999). *The Concise Oxford Dictionary*. Oxford: Oxford University Press. 1666 pp.
- Potter, R. B., Binns, T., Elliot, J. A. & Smith, D. (2004). *Geographies of Development*. Second ed. Harlow, England: Pearson Education Limited. 509 pp.
- Raven, P. H., Berg, L. R. & Hassenzahl, D. M. (2010). *Environment*. Hoboken, N.J.: Wiley. 589 pp.
- Redclift, M. (2005). Sustainable development (1987-2005): An oxymoron comes of age. *Sustainable Development*, 13 (4): 212-227.
- Republic of Kenya. (2010). *The Constitution of Kenya*. Nairobi: Kenya: National Council for Law Reporting.
- Republic of Kenya. (2011a). *The 2010 Long Rains Season Assessment Report*. Nairobi: Kenya Food Security Steering Group (KFSSG).
- Republic of Kenya. (2011b). *The 2010 Short Rains Season Assessment Report*. Nairobi: Kenya Food Security Steering Group (KFSSG).
- Republic of Kenya. (2011c). *The 2011 Long Rains Season Assessment Report*. Nairobi: Kenya Food Security Steering Group (KFSSG).
- Republic of Kenya. (2012a). *The 2011/2012 Short Rains Season Assessment Report*. Nairobi: Kenya Food Security Steering Group (KFSSG).
- Republic of Kenya. (2012b). *The 2012 Long Rains Season Assessment Report*. Nairobi: Kenya Food Security Steering Group (KFSSG).
- Ribot, J. C., Najam, A. & Watson, G. (2009). Climate Variation, Vulnerability and Sustainable Development in the Semi-Arid Tropics. In Schipper, E. L. F. & Burton, I.

- (eds) *The Earthscan Reader on: Adaptation to Climate Change*, pp. 117-160. London: Earthscan.
- Rohracher, H. (2008). Energy systems in transition: contributions from social sciences. *International Journal of Environmental Technology and Management*, 9 (2): 144-161.
- Ruud, A. (2006). Sustainable Development: A Useful Tool for Change? In Banik, D. (ed.) *Poverty, Politics and Development: Interdisciplinary Perspectives*, pp. 134-154. Bergen: Fagbokforlaget.
- Schacter, D. L., Guerin, S. A. & St. Jacques, P. L. (2011). Memory distortion: an adaptive perspective. *Trends in Cognitive Sciences*, 15 (10): 467-474.
- Schipper, E. L. F. (2009). Conceptual History of Adaptation in the UNFCCC Process. In Schipper, E. L. F. & Burton, I. (eds) *The Earthscan Reader on Adaptation to Climate Change*, pp. 359-376. London: Earthscan.
- Schipper, E. L. F. & Burton, I. (2009). Understanding Adaptation: Origins, Concepts, Practice and Policy. In Schipper, E. L. F. & Burton, I. (eds) *The Earthscan Reader on Adaptation to Climate Change*, pp. 1-8. London: Earthscan.
- Sen, A. (1999). *Development as freedom*. Oxford: Oxford University Press. 366 pp.
- Shongwe, M. E., van Oldenborgh, G. J., van den Hurk, B. & van Aalst, M. (2010). Projected Changes in Mean and Extreme Precipitation in Africa under Global Warming. Part II: East Africa. *Journal of Climate*, 24 (14): 3718-3733.
- Sumner, A. & Tribe, M. (2008). *International Development Studies: Theories and Methods in Research and Practice*. Los Angeles: Sage. 176 pp.
- Thagaard, T. (2009). *Systematikk og innlevelse: en innføring i kvalitativ metode*. 3. ed. Bergen: Fagbokforlaget.
- Thomas, A. & Mohan, G. (2007). *Research skills for policy and development: how to find out fast*. Los Angeles, California: The Open University. 363 pp.
- Throup, D. W. (2012). Kenya's Intervention in Somalia. *Center for Strategic and International Studies (CSIS)*. Available at: <http://csis.org/publication/kenyas-intervention-somalia> (accessed: 08.03.2013).
- Tol, R. S. J., Downing, T. E., Kuik, O. J. & Smith, J. B. (2004). Distributional aspects of climate change impacts. *Global Environmental Change-Human and Policy Dimensions*, 14 (3): 259-272.
- UiO. (2012). *Solar Transitions*: Department of Sociology and Human Geography, University of Oslo. Available at: <http://www.sv.uio.no/iss/english/research/projects/solar-transitions/about/> (accessed: 14.04.2013).
- Ulsrud, K., Winther, T., Palit, D., Rohracher, H. & Sandgren, J. (2011). The Solar Transitions research on solar mini-grids in India: Learning from local cases of innovative socio-technical systems. *Energy for Sustainable Development*, 15 (3): 293-303.
- Ulsrud, K. (2012). *The start-up and first weeks of operation at Ikisaya Energy Centre*, Field report: Department of Sociology and Human Geography, University of Oslo.
- Ulsrud, K. (2013). *The Ikisaya Energy Centre Model: Outcomes of the Development of a Pilot Project in Kenya*. Lecture given 11.04.2013 at MILEN Mini-Conference; "Development and Implementation of Technology, a Focus on Solar Energy", 11.-12.04.2013, Oslo: Norway.

- UNDP. (1997). Human Development Report 1997. *Human Development To Eradicate Poverty*. New York and Oxford: Oxford University Press.
- UNDP. (2013). *Discussion Paper: Kenya's Youth Employment Challenge*. New York: USA.
- Venema, H. & Rehman, I. (2007). Decentralized renewable energy and the climate change mitigation-adaptation nexus. *Mitigation and Adaptation Strategies for Global Change*, 12 (5): 875-900.
- Venema, H. D. & Cisse, M. (2004). *Seeing the light: adapting to climate change with decentralized renewable energy in developing countries*. Canada: International Institute for Sustainable Development.
- Vognild, R. (2011). *Renewable energy and climate adaptation: Exploring the role of solar power supply for climate adaptation on Moushuni Island, India*. Master thesis. Oslo: University of Oslo, Department of Sociology and Human Geography. 114 pp.
- Walliman, N. (2006). *Social research methods*. London: Sage. 224 s. pp.
- Wambua-Soi, C. (2012). Rising Xenophobia Against Somalis in Kenya. *Al Jazeera*. Available at: <http://blogs.aljazeera.com/blog/africa/rising-xenophobia-against-somalis-kenya> (accessed: 08.03.2013).
- Watson, R. T., Zinyowera, M. C. & Moss, R. H. (1996). *Climate change 1995: Impacts, Adaptations and Mitigation of Climate Change: Scientific-technical Analyses*. Contribution of Working Group II to the Second Assessment of the Intergovernmental Panel on Climate Change. Cambridge: Cambridge University Press. p. 878.
- WCED. (1987). *Our Common Future*. Report of the World Commission on Environment and Development, United Nations. Oxford: Oxford University Press.
- Whittaker, H. A. (2012). The Socioeconomic Dynamics of the Shifta Conflict in Kenya, c. 1963-8. *Journal of African History*, 53 (3): 391-408.
- Wijayatunga, P. D. C. & Attalage, R. A. (2005). Socio-economic impact of solar home systems in rural Sri Lanka: a case-study. *Energy for Sustainable Development*, 9 (2): 5-9.
- Wilhite, D. A. & Glantz, M. H. (1985). Understanding: the Drought Phenomenon: The Role of Definitions. *Water International*, 10 (3): 111-120.
- Winchester, H. P. M. & Rofe, M. W. (2010). Qualitative Research and Its Place in Human Geography. In *Qualitative Research Methods in Human Geography*, pp. 3-25. Oxford: Oxford University Press.
- Winther, T. (2013). *How to take the household perspective into account so as to obtain sustainable energy systems and a positive social impact*. Lecture given 11.04.2013 at MILEN Mini-Conference; "Development and Implementation of Technology, a Focus on Solar Energy", 11.-12.04.2013, Oslo: Norway.
- Wolff, C., Haug, G. H., Timmermann, A., Damste, J. S. S., Brauer, A., Sigman, D. M., Cane, M. A. & Verschuren, D. (2011). Reduced Interannual Rainfall Variability in East Africa During the Last Ice Age. *Science*, 333 (6043): 743-747.
- Yadoo, A. & Cruickshank, H. (2012). The role for low carbon electrification technologies in poverty reduction and climate change strategies: A focus on renewable energy mini-grids with case studies in Nepal, Peru and Kenya. *Energy Policy*, 42: 591-602.

Yin, R. K. (2009). *Case Study Research: Design and Methods*. Thousand Oaks, California: Sage Publications. 219 pp.

Appendices

Appendix 1: Interview guide for individual semi-structured interviews

Background information

1. *ID:*
2. *Date:*
3. *Location of interview:*
4. *Gender:*
5. How old are you?
6. Marital status?
7. Gender of head of household (and relation to head of household)?
8. Who normally lives in your household?
9. Which clan do you belong to?
10. Where do you live? (*Ngovovoni, Kyanzou, Mwalikanthi, Ndovoini, Ngiluni or Kalwa?*)
 - a. How far from the Energy Centre is that?
11. Were you born here in Ikisaya?
 - a. (If not born here:) When did you move here?
12. Do you own your house or rent it?
13. What kind of a house do you have;
 - a. Roof;
 - i. Corrugated iron roof
 - ii. Traditional roof
 - b. Walls;
 - i. Concrete walls
 - ii. Mud and pole walls
 - iii. Brick walls
14. Did you go to school?
 - a. *If yes*; which level did you complete?
15. Occupation/sources of income:
 - a. Agriculture;
 - i. What kind of crops do you grow?
 - ii. What is the size of the plot you grow?
 - iii. Is the produce used for home-consumption or sale?
 - b. Livestock;
 - i. What kind of livestock do you keep and how many?
 - c. Other sources of income?
16. How old are your children?

- a. (*If school age*): Do they go to school? At what level?
- 17. Are you currently, or have you been, a member of any community groups?
- 18. What kind of means of transportation do you use? (*Motorbike, bicycle or do you go by foot?*)
- 19. Does your household use firewood, charcoal or LPG for cooking?

Use of the Ikisaya Energy Centre

- 20. Are you or your spouse a member of the Ikisaya Energy Centre?
 - a. *If yes*;
 - i. When did you become a member?
 - ii. Why did you decide to become a member?
 - b. *If no*;
 - i. Why did you decide not to become a member?
 - ii. Do you plan on becoming a member?

- 21. What services provided by the Ikisaya solar Energy Centre do you use?
 - *If yes: specific questions about the different services the respondent uses.*
 - a. *Portable lanterns*
 - 21.1 How often do you go to get the portable lanterns?
 - 21.2 Who in your household goes to the centre to get the lanterns?
 - 21.3 Does he/she go by foot/bicycle/motorcycle/other to the centre?
 - 21.4 How much time do you/he/she spend on getting the lanterns?
 - 21.5 Where do you use the portable lanterns? (*Home: indoors, outdoors, what rooms? For business?*)
 - 21.6 Did you use another source of light before the Energy Centre opened? (*Kerosene lamps, torches etc.?*)
 - 21.7 What are the benefits of using the portable lanterns compared to what you used before?
 - 21.8 Do you save any money on using the portable lanterns compared to what you used before?
 - 21.9 Do you think the lanterns are better for your health compared to what you used before?
 - 21.10 Do your children use the lantern to do homework in the evening?
 - b. *Charging cell phone*
 - 21.11 For how long have you had a cell phone?
 - 21.12 How often do you charge your cell phone?
 - 21.13 What do you use your cell phone for?
 - 21.14 What are the benefits of having a cell phone?
 - c. *Computer*

21.15 What kind of documents have you had the Energy Centre typewrite for you?

21.16 What are the benefits of having access to this service here in Ikisaya?

d. Photocopy

21.17 What kind of documents have you photocopied?

21.18 How many times have you photocopied documents?

21.19 What are the benefits of having access to this service here in Ikisaya?

e. TV

21.20 How often do you watch TV at the Energy Centre?

21.21 What do you normally watch there?

21.22 What are the benefits of having access to TV?

22. Which service at the Energy Centre is the most important to you, and why?

23. Has the Energy Centre changed your daily life and activities? If so, how?

24. Do you use any of the Energy Centre services to get an additional income?

25. Have you been able to use the services during this drought?

26. Do you think any of the services provided by the Energy Centre help you cope with the ongoing drought?

If no: If the respondent has not used any of the services at the Energy Centre:

27. Why do you not use the services provided by the Energy Centre?

28. Would you like to use any of the services provided by the Energy Centre? Which?

29. Do you have a cell phone?

a. When did you buy it?

b. Where do you charge it?

c. How much do you pay to charge it?

d. Why do you not charge it at the Energy Centre?

e. What do you use your cell phone for?

f. What are the benefits of having a cell phone?

30. Do you have light in your home? What kind?

a. How much do you pay for it?

Consequences of the Energy Centre on the community

31. What do you think about the prices on the services provided by the Energy Centre?
(*Are they reasonable or too expensive?*)

32. Do you think many in the community cannot afford to use the services provided by the Energy Centre?

33. Do you think the Energy Centre has had any benefits to the local community here in Ikisaya since it opened?

34. Have there been any disadvantages or negative effects to the community?

35. Do you think the Energy Centre have had any effects on the educational situation in the community in general?
 36. Who do you think has benefited the most from the Energy Centre in this community?
 37. Who has benefited the least?
 38. How could the Energy Centre become more useful for you?
-

Climate variability and change

39. Do you follow any weather forecasts for this area?
 - a. *If yes;*
 - i. Where do you get the weather forecast from?
 - ii. Do you think these forecasts are reliable?
 - iii. Do you use these forecasts to plan daily activities/ productive activities etc.?
 - iv. Do you have any methods of predicting the weather yourself?
 - b. *If no;*
 - v. Would you like to have access to weather forecasts?
 - vi. Do you have any methods of predicting the weather yourself?
 40. Do you think the climate in this area has changed since you were younger?
 - a. *If yes;*
 - i. How has it changed?
 - ii. Do you do anything differently as a response to these changes?
-

The ongoing drought

41. Have you been affected by the ongoing drought in any way?
42. Has this drought been any different from previous droughts?
43. How much did you harvest last season?
44. How much did you harvest the season before that?
45. Do you still have some food from your last harvest, or do you have to buy all the food you consume now?
46. Did any of your livestock die because of this drought?
47. Do your goats or cattle produce less milk now because of the drought?
48. Have you been able to maintain the same amount of meals and the same quality as normal during this drought?
 - a. How many meals per day do you eat?
 - b. What kind of food do you eat?
49. Have you prepared for the coming rainy season?
 - a. Have you planted already?
 - b. What kind of crops have you planted?
 - c. Have you planted local seeds or hybrid seeds?
 - d. Will you able to buy enough seeds this season?
 - e. Do you use any fertilizer, pesticides, herbicides or manure on your agricultural plot?

- f. Do you have terraces on your farm?
 - g. Will you store any water during the rainy season?
50. Have you done any of the following activities to bring money or food to the household during this drought:
- a. Formal employment?
 - b. Casual labour?
 - c. Business?
 - d. Livestock sale?
 - e. Honey production?
 - f. Handicraft sale?
 - g. Charcoal production?
 - h. Brick production?
 - i. Group activities?
 - j. Have you received any help from neighbors or friends?
 - k. Have you received any famine relief from the church or the government?
 - l. Have you picked any exotic or indigenous fruits?
 - m. Hunting?
 - n. Other?
51. Which of these activities were the most important sources of additional food or income for your household?
52. Did the services provided by the Energy Centre help you in any of these activities?

Adaptive/coping capacity

53. Do you keep any savings of money?
- a. If yes; do you keep them in the bank?
54. Do you have any kind of formal insurance?
55. Have you ever borrowed any money from a bank or a microcredit institution?
- a. *If yes;*
 - i. When did you borrow money?
 - ii. How much did you borrow?
 - iii. Why did you borrow money?

Other issues

56. What do you think are the main challenges that this community faces?
57. Have you ever experienced theft or stealing of money, livestock or other items?
- a. What was stolen from you?
 - b. When did this happen?

Concluding questions

58. Do you have anything else you would like to add on this topic?
59. Do you have any questions for me?

