

**HOUSEHOLD VULNERABILITY AND ADAPTIVE CAPACITY TO IMPACTS OF
CLIMATE CHANGE AND VARIABILITY IN SOROTI DISTRICT, EASTERN
UGANDA**

BY

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DEDICATION

This work is dedicated to my late parents. For all the sacrifices you made for me

DECLARATION

This dissertation is my original work and has not been submitted to any other university for any academic award.

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ACRONYMS

IPCC	-	Intergovernmental Panel on Climate Change
GDP	-	Gross Domestic Product
SPSS	-	Statistical Package for Social Science
SSA	-	Sub Saharan Africa
UBOS	-	Uganda Bureau of Statistics
UNDP	-	United Nations Development Program
UNEP	-	United Nations Environment Program
ICRC	-	International Committee of the Red cross
UNFCCC	-	United Nations Framework Convention on Climate Change
GHGs	-	Green House Gases
FAO	-	Food and Agriculture Organization
IFPRI	-	International Food Policy Research Institute
OPM	-	Office of the Prime Minister
ENSO	-	ElNino Southern Oscillation
SLA	-	Sustainable Livelihood Approach
FGD	-	Focused Group Discussion

ABSTRACT

This study sought to examine the vulnerability and adaptive capacity of the people in Soroti District with the aim of improving the understanding of climate change and of measures to enhance adaptation and reduce vulnerability of the people in the district. The overall objective of this study was to assess the vulnerabilities, impacts and adaptation strategies of households in Soroti District. Household survey, key informant interviews and focused group discussions were used to obtain data on climate change and variability impacts, vulnerability and adaptation strategies. Temperature and rainfall data from Soroti meteorological station was also used to determine climate variability and change. All the quantitative data were entered in the Statistical Package for Social Science (SPSS) 16 and Microsoft-Excel 2007 program and results were then represented in the form of tables, graphs, and charts. The temperature and Rainfall analysis shows that climate in the area has been changing in the recent past. People's perception confirmed these scenarios along with increased floods, drought and incidences of pests and diseases. This could have serious implications on agriculture which is the major source of livelihood within the district. For instance the delay of the 2013 March – April – May (MAM) rainfall onset and extended dry spell in between the season led to serious crop failure and subsequent poor harvest. Other major impacts of climate change and variability on livelihoods include, lack of animal feeds, low fish catches, decreased water availability and decline in soil fertility.

Although, the entire district is vulnerable to the impact of climate change and variability, vulnerability is heightened on the poor, women, children and the less educated. The residents have however adopted certain coping and adaptation strategies to deal with the climate change impacts. The current coping strategies includes sale of household assets, wage labour, petty trading and reduction of consumption levels. Adaptation strategies include planting different crops, diversifying crops, shifting planting dates, off farm jobs and diversifying from farm to non – farm activities. However, these strategies are not sufficient due to overarching stressors such as overdependence on rainfed agriculture, poverty, lack of information and lack of technology among others. To improve resilience and enhance adaptation to climate change and variability, there is an urgent need to alleviate poverty and unemployment within the district by enhancing the micro-financing efficiency and creating employment opportunities for the locals. There is also a need for the involvement of the relevant institutions on early warning and robust contingency planning. Local knowledge integration in climate policies can also improve adaptation and enhance resilience.

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CHAPTER 1: INTRODUCTION

Climate change and variability has become a local phenomenon just as it is global. Its magnitude is now being felt at almost all scales and in all regions with extreme events such as drought, excessive rainfall, heat waves as well as dry spells affecting much of rural Africa (Adger, 2000). IPCC, (2001a) indicates that scientific evidence of human-induced global warming is unequivocal, worse than previously estimated. The report states that Africa warmed by 0.7°C in the last century and projected warming for the 21st century for Africa ranges from 0.2 °C (low scenario) to over 0.5°C (high scenario) per decade. Therefore, urgent action needs to be taken in order to respond to these on-going changes. Warming is projected throughout the continent and in all regions, although there is variability in the magnitude and speed of change. Increases in anthropogenic emissions of gases (e.g., carbon dioxide and methane) into the atmosphere, and a resultant enhanced greenhouse effect, have been shown to be the major driving force behind the observed trend of accelerated global warming that has taken place over the last century (IPCC 2007a, (IPCC, 2001a; IPCC, 2007 ; Adger, 2000).

The actual and potential impacts of climate change and variability in Africa are large and wide ranging, affecting many aspects of people's everyday lives. Many climate models predict negative impacts of climate change on agricultural production and food security in large parts of sub - Saharan Africa (SSA) (Nanduddu, 2010). Increase in temperatures, the drying up of soils, increased incidences of pests and diseases, shifts in suitable areas for growing crops and livestock, floods, deforestation, and soil erosion are all indicators that climate change is already happening and represents one of the greatest environmental, social and economic threats facing Africa (UNFCCC, 2007). As far as development is concerned, climate change will have a strong impact on Africa's ability to achieve the Millennium Development Goals (MDGs) and on its development policies in general, with increased pressure on agriculture, water supply and demand, health, and political stability (FAO, 2008). There is a consensus that African countries are the most vulnerable to the impacts of climate variability and change. This is attributed to the continent's low adaptive capacity, over-dependence on agricultural sector, marginal climate and existence of many other stressors. Most countries in Africa are poor, debt distressed, and marginalized. Drought, diseases, civil conflict and poor governance make the situation worse (Nanduddu, 2010; IPCC, 2001a,). Agriculture, which provides a livelihood for about three-quarters of Africa's population, is

mainly rain-fed. It contributes to between 20-50% of the gross domestic product (GDP) and employs over 70% of the population. This means that any change in weather and climate will have negative effects on agricultural production, employment and overall livelihoods of the most vulnerable groups in the continent. Severe and prolonged droughts, flooding and loss of arable land due to desertification and soil erosion are reducing agricultural yields and causing crop failure and loss of livestock, which endangers rural and pastoralist populations. (IPCC, 2007; Eriksen, 2000). IPCC, 2007 predicts that by 2020, crop yields from rain-fed agriculture in Sub Saharan Africa (SSA) may fall by up to 50%, and 75-250 million people could be affected by increased water shortages. The Horn of Africa's pastoralist areas (Ethiopia-Kenya-Somalia border) have been severely hit by recurrent droughts; livestock losses have plunged approximately 11 million people dependent on livestock for their livelihoods into a crisis and triggered mass migration of pastoralists out of drought-affected areas (FAO,2008).

Like in the other sub-Saharan countries, agriculture is the largest sector of economy in Uganda contributing up to 42% of the Gross Domestic Product (GDP) and providing employment to 66 % of the total working population (UBOS, 2011). However, productivity and competitiveness of this sector is increasingly constrained by temporal and spatial variability of climate (Ekere, 2012). This study therefore aimed to assess the vulnerability and adaptive capacity of the local people to the impacts of climate variability in Soroti district with the view of suggesting strategies to enhance resiliency of the people. Increasing the capacity of vulnerable people to adapt to the impacts of climate variability is essential to sustainable development and future economic growth in Africa. A better understanding of the nature of vulnerability, including its components and determinants in the context of climatic variations is needed to understand household's adaptive capacity and how this might be improved particularly at the local level.

1.1 Problem Statement

Uganda like many countries in sub- Saharan Africa is highly susceptible to climate variability and change. The economy as well as the wellbeing of its people is dependent on rain fed agriculture therefore a change in climate may mean increased food insecurity, soil erosion and land degradation, over flooding leading to damages in infrastructure and settlements and an outbreak of diseases like malaria (Twinomugisha, 2005). Communities located in remote areas and have limited access to social services and limited opportunity to influence the policies that affect their lives are, therefore, likely to be more vulnerable (Orindi and Eriksen,

2005). Uganda has been experiencing an increase in the frequency and intensity of extreme weather events with serious socio-economic consequences. In the 1991–2000 decade alone, Uganda experienced seven drought episodes. Extreme droughts had significant negative effects on water resources, hydropower production, agriculture and the overall economy (UNDP, 2009; Wasige, 2009). The 1997/98 El Nino is reported to have inflicted heavy losses. For instance, it swept bridges, crops were destroyed, and outbreak of water borne diseases such as cholera and other flood-related diseases were experienced. It is estimated that 100 people were killed by floods and landslides and 150,000 displaced from their homes as of December 1998 (Wasige, 2009). Higher-than-normal rains between July and October 2007 caused flooding in eastern Uganda, where Soroti, Amuria and Katakwi districts were the most affected. Water inundated many areas, leading to heavy loss of first-season crops that were harvested in July/August (UNEP, 2009). In February 2010; Eastern Uganda experienced flooding, water logging and landslides due to heavy rains. A report by the International Committee of the Red Cross (ICRC) indicated that the floods and landslides resulted in deaths, displacement of people and destruction of property. Food crops were destroyed and roads were inaccessible. Districts that were mostly affected include: Soroti, Katakwi, Amuria, Pallisa, Mbale, Moroto, Bukwo and Budaka (ICRC, 2010).

This study sought to examine the vulnerability and adaptive capacity of the people in Soroti District with the aim of improving the understanding of climate change and of measures to enhance adaptation and resilience of the people in the district. This is especially important since Soroti district is increasingly becoming climate sensitive as witnessed from the recent extreme climatic events. This study is timely as adaptation has become a focus of policy in the United Nations Framework Convention on Climate Change (UNFCCC). In addition, identifying and implementing adaptation measures to reduce vulnerability to current and future climate variability contributes to reducing vulnerability to future changes in climate. Identification of the major aspects of vulnerability and its magnitude helps in assessing the degree of sustainability of livelihoods that the community owns. It is against this background that this study sought to provide answers to the following questions among others -

1. What are the trends in rainfall and mean surface temperature in the district?
2. How are livelihoods affected by climate variability?
3. Who are most vulnerable to climatic shocks and why?
4. What are the coping and adaptation strategies employed deal with climate change and variability.

1.2 Objective of the study

The general objective of this study is to assess the vulnerability and adaptive capacity of households to the impacts of climate variability in Soroti District.

1.2.1 Specific Objectives

1. To examine the local's perception and trends in rainfall and mean surface temperature in the district
2. To assess the impacts of climate variability on livelihoods
3. To assess the most vulnerable groups within the district
4. To examine the adaptation strategies of the locals to changes in climate.

1.3 Hypotheses

1. H_0 There is no significant variation in climatic extremes such as floods and drought across different villages in Soroti district
 H_1 There is a significant variation in climatic extremes such as floods and drought across different villages in Soroti district
2. H_0 Vulnerability to climatic extremes does not vary significantly with the education levels of the household heads
 H_1 Vulnerability to climatic extremes varies significantly with the education levels of the household heads

1.4 Justification

As noted in 1.0 above, the world is warming and Uganda is no exception. An analysis of climate variability impacts and community adaptive capacity is important for understanding the nature of risk and vulnerability associated with changing climate and for formulating various interventions for effective mitigation (Benson and clay, 1998). The identification of factors that shape vulnerability and the documentation of the type and sequence of adaptive strategies can inform policies and programs to reduce exposure to risk, prioritize interventions and to enable those affected to recover in timely fashion (Downing *et al.*, 2001; Adams *et al.*, 1998; Benson and Clay; 1998). The need of vulnerability assessment in grassroots level is also very essential due to the fact that large numbers of adaptation programs tend to fail simply because they are not able to properly identify the major aspects and magnitude of vulnerability of the community where projects are to be launched (Leary *et al.*, 2001).

Adaptation, in the context of climate variability, includes actions that people take in response to actual or projected variations in climate, to minimize adverse impacts or take advantage of the opportunities created by the variations (Adger, 2000). Adaptation can therefore be reactive; undertaken in response to the impacts of current climate variability or change; or anticipatory, implemented before the impacts are observed (Klein, 2002). This study therefore explored how the local people in Soroti district are able to sustain their livelihoods and deal with climatic uncertainties within their social networks. This knowledge would enhance the theoretical and empirical understanding of their indigenous ways of coping with climate variability and change. An analysis of the differing abilities of communities to absorb and recover from climate shocks has been highlighted as key to a definition of sustainability (Watson 2010; Klein, 2002). According to Klein (2002) a sustainable livelihood is not like a substance which can be borrowed from outside - real livelihood sustainability cannot be purchased with foreign aid or assistance, but rather it depends on people's ability and interest for using the local resources efficiently. The ability to adapt even under challenging and changing environments in the past implies that there is much wisdom held by the local communities that need to be understood.

Soroti District is located in Teso sub region of eastern Uganda. The sub-region is considered prone to climate hazards, the recent ones being the 2007 flood and the 2009 drought that hit the same area. Due to these series of shocks, the sub region continues to be one of the least developed areas in the country (Nanduddu, 2010). The findings of this study will hence guide policy makers and local community to build up the resilience and adaptive capacity to cope with the adverse influences of climate variability and make the social-ecological system more sustainable. Finally, the findings of this study add to the existing body of literature on climate variability impacts, vulnerability and adaptation.

1.5 Scope of the study

The study was conducted in Soroti district, Eastern Uganda. Out of the ten sub counties in the district, the survey was conducted in only three Sub - Counties which were considered to be representative of the entire district. Climate change and variability encompasses variables such as rainfall, temperature, evaporation, evapo - transpiration, humidity, sunshine and wind among others. This study however considered rainfall and temperatures as the critical element that influences livelihoods and exploitation of natural resources such as water and land. Thus the significance of climate change and variability in this study is limited to the understanding of temperature and rainfall variability.

CHAPTER 2: LITERATURE REVIEW

2 Introduction

This chapter reviews the cause of climate change and variability and its impacts especially on African countries. The impact can be explained in terms of extreme weather events, unpredictable temperatures as well as projections of the effects on agriculture and food security, biodiversity and water resources. This chapter also focuses on vulnerability of different systems to impacts of climate change and factors that enhance vulnerability. It further explores how countries perceive climate change and variability and how they have adapted to it. Perceptions differ from country to country and some perceptions are based on beliefs and norms. Also mentioned is that adaptation measures vary depending on different social, economic, political and environmental factors.

2.1 Climate change and variability

There is acceptance by the scientific community, as well as growing body of evidence, that the composition of the global atmosphere has been altered, and that the global climate is changing. Available data show that air temperature near the earth surface rose by 0.74 °C from 1906 to 2005 and scientists estimate that it could increase by as much as 6.4 °C on average during the 21st century. The cause of such warming has been identified as mainly increasing atmospheric emission of greenhouse gases (GHGs) (IPCC, 2007). Some of the evidence of global warming already observed include changes in mean temperature and precipitation patterns, shifts in seasons and sea level rise (IPCC, 2001a; Benson and Clay, 1998; Aslanyan, 1999). These are predicted to be characterized by extreme droughts and very wet periods due to flood events. (IPCC, 2001a).

Even though the impact of climate variability and change is a global concern, the impact is particularly significant in Africa. This is attributed to the continent's low adaptive capacity, over-dependence on agricultural sector, marginal climate and existence of many other stressors. Experts and scholars predict that climate change will particularly be devastating for developing countries, since they have poor financial, institutional, technological, and human capacities to cope with its consequences (Aslanyan, 2009). It is however important to understand that there is a significant difference between climate change and climate variability (Smit *et al.*, 2000). IPCC, (2001a) defines climate change broadly as any change in climate over time whether due to natural variability or as a result of human activity. The United Nation's Framework Convention on Climate Change (UNFCCC) on the other hand

defines climate change as a change of climate that 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. Climate variability, on the other hand, refers to short-term fluctuations that occur from year to year as well as variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all temporal and spatial scales beyond that of individual weather events (IPCC, 2001a). It is important to note that changes in individual weather events will potentially contribute substantially to changes in climate variability. Both climate change and climatic variability of a particular region are influenced by its geographical characteristics such as the sea or water body, ground surface and atmospheric interactions, solar activities and human interventions. A fundamental understanding is that changes in the global climate have local impacts and that it is not possible to treat variability separately from climate change (Smit *et al.*, 2000).

2.2 Impacts of Climate Variability and Change

2.2.1 Agriculture and Food security

The impact of climate variability and change represents a major challenge to sustainable development, food security and poverty reduction in Africa partly because the climatic changes that have already occurred and which are still expected are more pronounced in Africa than in other regions of the world. This is also due to the economic and social importance of agriculture in many countries in Africa yet the agricultural sector in the majority of sub-Saharan countries is already unable to provide a sustainable livelihood for the growing rural population, let alone to ensure national food security (FAO, 2008; IPCC, 2007). Among the socio-economic impacts of climate variability are falling incomes from agriculture, higher risks and greater vulnerability for the rural population due to changes in their cultural and economic livelihoods, and the risk of rural areas sliding ever deeper into poverty. FAO (2006) claims that climate change and variability will worsen the living conditions of farmers, fishers and forest-dependent people who are already vulnerable and food insecure.

Extreme weather events have always occurred periodically in rural areas south of the Sahara, but it is generally agreed that climate variability and change will cause farming conditions to deteriorate further throughout large parts of Africa (Jones and Thornton, 2003). The Intergovernmental Panel on Climate Change estimate that as a result of climate change and

variability the vegetation period in parts of western and southern Africa will shorten by an average of 20 percent by 2050 and cereal yields in these regions could decrease by up to 40 percent without appropriate adaptation measures (IPCC, 2007). On the other hand the International Food policy Research Institute estimates that cereal production growth for a range of crops in Sub Saharan Africa will decline by a net 3.2 percent in 2050 as a result of climate change and that food prices for all staple crops will increase because climate change acts as an additional stressor on the already tightening price outlook. IFPRI (2010), also indicate that under climate change and variability, child malnutrition have increased by an additional 0.5 million children in 2010, would be higher by 1 million children in 2030, and would still be higher by 0.6 million children by 2050. According to FAO (2008), an estimated 850 million people in the world today suffer from hunger. Of those, about 820 million (more than 95 per cent) live in developing countries which are expected to be most affected by climate change.

Food security status in Uganda is already worrying. The share of Ugandans suffering from food insecurity measured in terms of caloric intake is alarmingly high with low rates of income poverty (Kasirye, 2010). During May-July 2009; Uganda experienced a major food crisis - with famine and acute food shortage. According to the Office of the Prime Minister (OPM), at least 17 districts - mainly in the sub-regions of North East and West Nile, faced famine while a further 31 districts faced acute food shortages. This shortage was the outcome of delayed rains experienced during the beginning of 2009.

2.2.2 Impacts on Water Resources

Water resources in particular comprise one sector that is highly dependent on and influenced by climate change and variability. A number of countries in Africa already experience considerable water stress as a result of insufficient and unreliable rainfall that changes rainfall patterns or causes flooding (Ogallo, 1979). Effects of global climate change that have implications for water resources include increased evaporation rates, a higher proportion of precipitation received as rain, earlier and shorter runoff seasons, increased water temperatures and decreased water quality in both inland and coastal areas (Ngigi, 2009)

Substantial inter-annual variations in precipitation are currently being observed throughout Africa. In some years extreme events such as floods and droughts lead to too much or too little surface water with far reaching physical, environmental and socio-economic impacts. In many countries of Africa a single drought or flood can draw back by many years national socio-economic development growth. Climate extremes are also linked to many regional

conflicts and insecurity when societies compete over limited water, food and grazing lands (Ogallo, 1979; Nicholson, 2001).

IPCC, (2001a) indicates that climate change is real and that pollution from human socio-economic development activities is responsible for the observed anthropogenic climate changes. The IPCC assessment also states that both droughts and floods have increased in frequency and severity in recent years, and are projected to increase in many areas of the world, with far-reaching implications on the demand and availability of freshwater resources. IPCC (2007) has further shown that the African continent is the most vulnerable continent to climate change. The change of available water resources due to climate change can alter the robustness of water resources systems (e.g. water allocation systems, hydropower sites, etc. Increased stream temperatures with increased air temperature by global warming and changes in the hydrological cycle are projected to affect water quality and exacerbate many forms of water pollution such as sediments, nutrients, pathogens, pesticides and salt, as well as thermal pollution, which could possibly affect ecosystems, human health, and water system reliability and operating costs (Nicholson, 2001; IPCC, 2007). Climate change is therefore a key challenge facing sustainable freshwater availability, security and the general sustainable development of the African continent in the 21st century.

2.2.3 Impacts on Biodiversity

Climate change and variability is both a cause and an effect of biodiversity change. It is also considered to be the main driver of change in the geographical distribution of crops and livestock species, harvested wild species, pests, predators and pathogens along with anthropogenic dispersion. It is a consequence of the way in which biological resources are converted into useful goods and services, and especially of the way in which grasslands and forests are converted into croplands (Eakin and Luers, 2006).

Millennium Ecosystem Assessment (2005) report indicates that climate change is already inducing an adaptive response on the part of the world's biota. This includes changes in species distributions and abundance, changes in the timing of reproduction in animals and plants, changes in animal and bird migration patterns and changes in the frequency and severity of pest and disease outbreaks. Some of these effects are the direct result of changes in temperature, precipitation, sea level or storm surges. Others are the indirect effect of changes in, for example, the frequency of fire. In general, species are moving from lower to higher elevations and from lower to higher latitudes, although the rapidity of the response

varies very considerably. In any given ecosystem, changes in the frequency and intensity of disturbances determine the rate at which plant and animal assemblages will change.

IPCC (2007) report highlighted the impact of climate change on the distribution of a number of infectious disease vectors, and the seasonal distribution of some allergenic pollen species. Diseases that were previously limited to low latitudes have spread to higher latitudes. Insect borne diseases such as *trypanosomosis* and *anaplasmosis* are now found in parts of the world where their vectors have never been found in the past. Climate, in association with land use change, has been associated with global increases in morbidity and mortality from emergent parasitic diseases. Changes in the distribution of diseases and disease vectors are problematic because they involve a disassociation between the pathogen and its natural controllers. The disruption of the community of organisms that keeps a pathogen in check allows it to spread rapidly. For the same reason, climate change is expected to increase the frequency with which species across a wide range of taxa are able to spread outside their home range (IPCC, 2007).

A study on the implications of climate change for the potential invasibility of all terrestrial ecosystems concluded that a high proportion of existing ecosystems will become vulnerable to invasion by species from elsewhere under even moderate climate change scenarios. Among marine systems, coral reefs are thought to be particularly vulnerable to climate change. Temperature increases and ocean acidification are expected to compromise carbonate accretion putting corals increasingly at risk. They are also expected to exacerbate the effects of other anthropogenic stresses (Hoegh-Guldberg *et al.*, 2007).

2.3 Vulnerability to Climate change and variability

A wide range of disciplines use the term ‘vulnerability’, from economics and anthropology, to psychology and engineering, as well human geography and ecology. The concepts and definitions used by different scholars revolve around the explanation of lack of adaptive capacity in both social and natural systems (Adger, 2000; Adger and Kelly, 1999; Cutter, 1996; Downing 1991). IPCC, (2001b) describes vulnerability as: “The degree to which a system is susceptible to, or unable to cope with adverse effects of climate change, including climate variability and extremes”. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity and its adaptive capacity. Therefore, vulnerability to climate change within this IPCC vulnerability context is defined as a characteristic of a system and as a function of its exposure, sensitivity and adaptive capacity (Adger, 2000)

Adger and Kelly (1999) underpin vulnerability in terms of capacity of individual and social groups to respond to *i.e.* coping with, recovering from and adapting to any external shocks that may affect their livelihood or well-being. In this context, resource accessibility for the groups is considered as a key determinant for vulnerability. They focus on the land ownership pattern as a capacity indicator, which finally indicates the extent of resource accessibility. (Table 1)

Table 1: Types of Vulnerability

Types of Vulnerability	Causes in relation to climate extremes	Indicators of vulnerability
Individual vulnerability	Relative and absolute poverty; entitlement failure; resource dependency	Poverty indicators; Proportion of income dependent on risky resources; dependency and stability.
Collective (group) Vulnerability	Absolute levels of infrastructure development; institutional and political factors; insurance; formal and informal social security	GDP per capita; relative inequality; qualitative indicators of institutional arrangements

Source: Adger , 1999

A study conducted in Bangladesh by Brouwer *et al.*, 2007, shows that households with lower income and less access to productive resources are more vulnerable in terms of climatic risk exposure. Besides, both income and asset disparity induce the households to be more exposed to various risks and thus, become more vulnerable. They also show that under the climatic shock, and with presence of income and asset disparity, individual households become more vulnerable at collective or community level since the collective level is least capable to face a common shock like cyclone or floods. O'brien and Mileti (1992) while examining the vulnerability to climate change stated that in addition to economic well-being and stability, being important in the resilience of populations to environmental shocks, the structure and health of the population may play a key role in determining vulnerability. Age is an important consideration as the elderly and young tends to be inherently more susceptible to environmental risk and hazard exposure. Generally populations with low dependency ratio and in good health are likely to have the widest coping ranges and thus be least vulnerable in

the face of hazard exposure. Another study by Handmer *et al.*, (1999) on coping mechanisms to environmental shocks brought about by biophysical vulnerability reveals that factors like institutional stability and strength of public infrastructure are of crucial importance in determining the vulnerability to climate change. A well connected population with appropriate public infrastructure will be able to deal with a hazard effectively and reduce the vulnerability. Such a society could be said to have low social vulnerability.

Africa is said to be the continent that is the most vulnerable to the impacts of climate change as a result of national economies that are largely dependent on natural resources (Eriksen, 2000). It is now understood that Africa and particularly the poor will be hardest hit by climate change due to low adaptive capacity. Many factors compound the impacts of climate change in Africa and undermine adaptive capacity. These factors include poverty, illiteracy and lack of skills, weak economies, limited infrastructure, weak institutions, lack of technology and information, poor access to resources, low management capacities and armed conflicts (Deressa *et al.*, 2008). Several millions of people regularly suffer impacts from droughts and floods. Droughts have mainly affected the Sahel, the Horn of Africa and southern Africa, particularly since the end of the 1960s (UNDP 2009, Eriksen, 2000; Deressa *et al.*, 2008). Floods are also critical and impact on African development. Recurrent floods in some countries are linked, in some cases, with ENSO events. When such events occur, important economic and human losses result 2005. Even countries located in dry areas (Algeria, Tunisia, Egypt, Somalia) have not been flood-free (ACCCA,2010).

2.4 Adaptation to Climate Change and Variability

Adaptation to climate is the process through which people reduce the adverse effects of climate on their health and well-being, and also take advantage of the opportunities that their climatic environment provides (Smit *et al.*, 2000). One of the more commonly used definitions for adaptation, in the climate change context, is suggested by the IPCC (2001a) who define adaptation as an adjustment in human or natural systems in response to observed or expected changes in climatic stimuli and their effects and impacts in order to alleviate adverse impacts of change or take advantage of new opportunities. This includes the ability to prepare for climate impacts and opportunities in advance, as well as the ability to respond to its effects (IPCC, 2001a). Effective adaptation strategies imply reducing present and future vulnerability to climate change and include coping strategies or changes in practices and processes in light of the perceived climatic change. Such actions can be taken by individuals, households, governments and other stakeholders. Adaptation may include policy measures

that reduce vulnerability and enhance adaptive capacity, or the ability of people and systems to adjust to climate change (Smit *et al.*, 2000).

The IPCC (2001b) identified factors that determine the capacity of social, ecological, or economic systems to adapt to climate change impacts. There is a complex mix of conditions that determine a society or community's ability to adapt to climate change and impacts. Drawing on this literature, the IPCC identified the following determinants of adaptive capacity:

- a. The availability of and access to technological options for adaptation;
- b. The availability of capital resources;
- c. The structure of critical institutions;
- d. Human and social capital;
- e. The system's risk-spreading process;
- f. The ability of decision makers to manage information; and
- g. The public's perceived understanding of the risk (Yohe, 2002; IPCC, 2001b).

2.4.1 Types of Adaptation

Adaptation can occur via a huge variety of processes and forms. Depending on timing they can either be proactive or reactive, meaning that they are motivated by predictions of an event in the future or as a response to a started event (Klein and Macleaver 1999; Yohe, 2002). They can also be autonomous or planned, sometimes also referred to as private or public, depending on the actors who adapt, i.e. a household or a state agency (Yohe, 2002). Smit *et al.* (2000) describe autonomous adaptation as those that occur naturally, without interventions by public agencies and policies. Planned adaptation is 'based on an awareness of anticipated climate change, and involves conscious human intervention in a system to protect or enhance its desirable traits. Actions taken by farmers or individual households are usually referred to as 'autonomous adaptation', while actions taken by governments as conscious policy decisions are referred to as 'planned adaptation' (Klein and Macleaver, 1999).

Moreover, adaptations may have different spatial scope, either local or widespread and take different forms, i.e. technological, behavioral, financial, institutional or informational. Disaster preparedness, building of flood trenches and walls or state subsidies of drought resistant crop varieties are examples of proactive and planned adaptations, while disaster recovery, emergency migration and crop diversification can be seen as reactive and autonomous adaptation on various levels (Smit *et al.*, 2000).

2.4.2 Africa's Adaptive Capacity

Smithers and Smit (1997) comment that changes in climate are expected to have ecological and socio-economic impacts. Thus the extent to which ecosystem, food supplies, and sustainable development are vulnerable or "in danger" depends on exposure to changes in climate and on the ability of the impacted system to adapt' (IPCC, 2001b)

The capacity to adapt depends largely on the assets (natural resource, human and social, physical and financial capital) that one has or can access and how well these are utilized (Klein and Macleaver, 1999). The adaptive capacity of human systems in Africa is generally considered to be low due to lack of economic resources and technology. Similarly, vulnerability is considered high due to the heavy reliance on rain-fed agriculture, frequent droughts and floods, and poverty in many African countries (Eriksen, 2000).

According to Adger (2000), populations have developed a number of coping and adaptation strategies in order to live with climatic variations and uncertainty, such as diversification of crops and sources of income, migration, reliance on remittances and social networks of support. These adjustments largely take place within informal economic sectors and most poor people have little access to formal support or investments (Adger, 2000; Smithers, J, and Smit, 1997).

Maddison (2007) on the perception and adaptation to climate change in Africa reveals that the factors that affect the farmers' perception and adaptation to climate change are location, financial constraint, lack of appropriate seed, market accessibility, farming experience, access to free extension advice, level of education, farm size, tenure in the form of land borrowing, current climate. Being head of the household also increases the probability that the farmer can adapt, perhaps because he or she is in control of household resources. There is, however, no evidence that gender influences the probability of adaptation. With Regards to the adaptation options, this study found out that in all countries apart from Cameroon and South Africa the planting of different varieties of the same crop is considered to be one of the most important adaptation methods to climate change.

However a study conducted by Deressa *et al.*, (2008) in Ethiopia found out that the level of education, age, sex and household size of farmers are the significant determinants of adaptation to climate change in the study area. Using cross-sectional data from a survey of farmers to illicit information on adaptation methods, the study found out that the adaptation methods currently in place in the study area are; changing planting dates, using different crop varieties, planting tree crops, irrigation, soil conservation and not adapting. The farmers

reported that the use of different crop varieties was the most common adaptation method, while irrigation was the least common. They also reported that the reasons for not adapting are lack of information on climate change impacts and adaptation technologies, lack of financial resources, labour constraints and land shortages.

The socio-economic team of Advancing Capacity to support Climate Change Adaptations (ACCCA, 2010) employed a Multivariate Probit model to analyze data from a survey of 160 farm households in northern Ethiopia. The main aim of this study was to analyze the factors influencing the farmers' decision to adapt. The study revealed that Extension service, livestock ownership by female farmers, access to climate change information and the observed change in temperature have positive and substantial impact on adaptation to climate change. The findings also indicated that the most common adaptation strategies include: use of different crop varieties, soil and water conservation, changing planting dates, use of external fertilizer, borrowing lost local crops from community, and using short duration crops.

Kurukulasuriya and Mendelson (2007) on the other hand used the Multinomial Logit Model to analyze crop and livestock choice as climate change adaptation options in Burkina Faso, Cameroon, Ghana, Niger, Senegal, Egypt, Ethiopia and Kenya, South Africa, Zambia and Zimbabwe. The study on crop choice showed that crop choice is climate sensitive and farmers adapt to changes in climate by switching crops. The results of the choice models from the livestock study showed that farmers in warmer temperatures tend to choose goats and sheep as opposed to beef cattle and chicken. Goats and sheep can do better in dry and harsher conditions than beef cattle.

A study conducted in Tanzania indicated that Farmers switch between crops, alter the mix of crops they grow and change the timing of planting in the light of evidence they obtain of the growing season (O'Brien *et al.*, 2000). For example, farmers may switch from maize to sorghum and/or cassava when there is a threat of drought and switch to rice or banana when rainfall is abundant. The study also found out that in parts of Morogoro non-farm income has become consistently more important since the mid-1980s and it has compensated for the decline in farming. Many households tap natural resources in order to cater for their subsistence needs and to earn cash income. For example, forests provide timber, firewood, fruits, fodder, traditional medicines and meat for subsistence needs. Moreover, trees are harvested for the production of timber and charcoal for local and more remote markets and the fuel wood obtained from the forests is used for energy-intensive production of bricks.

Another study carried out by Kasirye (2010) found out that farmers in Uganda use mixed cropping and diversification of crops as a form of insurance against rainfall variability and pests attack. The risk of complete harvest failure due to a climatic event such as drought, intense rainfall or high or low temperature spells, is reduced by having different crops in the same field or various plots with differing crops since not all crops and fields are affected the same way by such climate events (Kasirye, 2010). Irrigation, providing crops with water from rivers and streams, is another strategy to compensate for unreliable rainfall conditions. Irrigation may allow the growing of crops such as vegetables in areas of low rainfall as well as during the dry season and droughts. These may form an alternative source of food and income when rainfed crops fail. In some areas, flood waters are trapped and used for growing crops after the floods have receded (Nanduddu, 2007; PELUM, 2010).

Ekere (2012) conducted a study on farmers' preference for adaptation methods in Eastern Uganda and found out that microfinance, agricultural extension systems and basic education in farmers' as the major factors affecting adaptation decisions. The study revealed that those who were willing to adapt had higher levels of both formal and informal education. Less-educated individuals and those on lower income levels are the vulnerable segment and neglected by extension services and interventions (Ekere, 2012).

A number of studies (Kurukulasuriya and Mendelson,2007; Derressa *et al.*,2008; ACCCA,2010; OBrein,2000) have been conducted in Sub Sahara Africa on climatic and weather variability, adaptation, crop production and household food security. However, most studies have concentrated on farmers' perception and adaptation strategy to the impacts of climate change production and less on vulnerability and factors that hinder effective adaptation. To bridge this gap, this study examined the vulnerable groups and factors that hinder effective adaptation to the impacts of climate change and variability in Soroti District. Much of the literature has also focused on the long-term effects of climate change on agricultural production, looking at trends in temperature, precipitation, and changes in season length. However, this study also considered the short-term effects of seasonal weather variability on livelihood sources.

Most impact and adaptation studies have been based on climate change scenarios that provide a limited set of possible future climates - invariably specified as average annual conditions such as temperature and precipitation (Wang, 2012 ; Orindi and Eriksen, 2005 ;Deressa, 2006 ; Ouedraogo *et al.*, 2006 ; Kurukulasuriya and Mendelson,2007). Yet the climate change-related stimuli for which adaptations are undertaken are not limited to

changes in average annual conditions; they include variability and associated extremes. Climatic conditions are inherently variable, from year to year and decade to decade. This study therefore incorporates vulnerability and adaptation to both climate variability and change.

Similar studies that have been conducted in the Teso sub region and in particular Soroti district have largely focussed on farmers' adaptation to climate change without giving considerations to vulnerability (Eguru,2011; Nabikolo,2012; Ekere, 2012) yet identification of the major aspects of vulnerability and its magnitude helps in assessing the degree of sustainability of livelihoods that the community owns. This study therefore examined the vulnerable groups and factors that enhance vulnerability of households to the impacts of climate change and variability in Soroti District.

2.5 Theoretical Framework and conceptual framework

2.5.1 Political Economy Approach

The political economy/political ecology framework is also known as the social constructivist framework. Its perspectives on vulnerability emphasizes the socio - political, cultural, and economic factors that together explain differential exposure to hazards, differential impacts, and most importantly, differential capacities to recuperate from past impacts and/or to cope and adapt to future threats (Eakin & Luers, 2006). This approach introduces a household perspective on vulnerability, and replaces the eco - centric approach to environmental change. It argues that vulnerability should be treated as a condition of people that derives from their political-economic position and it is therefore 'dangerous' to use it loosely or as a characteristic of exposure to hazards alone, since this allows for the key components of power and income distribution to be played down and prominence given to technical fixes. Political economy denotes the social and economic response capacity of individuals and groups to a variety of stressors, with its main concerns being; who is most vulnerable and why? (Fussel, 2005). However, Eakin and Luers (2006) argue that the absence of a clearly defined vulnerability outcome within this framework has produced only generic descriptions of inequities in resource distribution and relationships that relate to the differential susceptibility to harm.

The political economy approach has been shown to have utilitarian and theoretical value in the two main elements encountered in this study that is vulnerability and adaptation to climate change and variability. It also provides a broad multidisciplinary framework capable

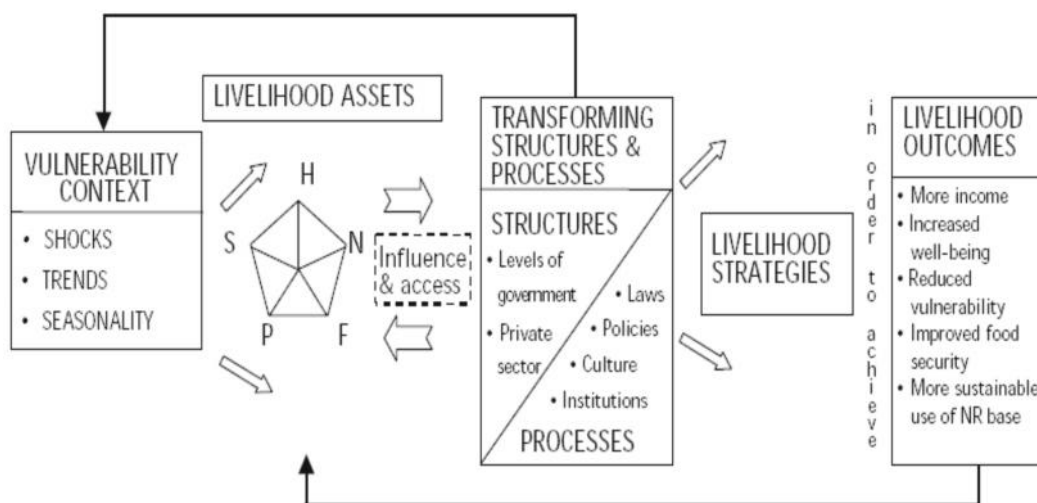
of incorporating a myriad of factors including economic, social and political elements, which are necessary for the explanation of the research findings (Watts, 1983). Political economy is particularly helpful in showing how people who are affected by climate change and variability may be differentially vulnerable (Watts 1983; Downing *et al.* 2001). According to Downing *et al.* (2001), vulnerability depends on human infrastructure as well as socio-economic conditions. Furthermore, household vulnerability may be generated by economic, social and political processes that influence how climate affects them in varying ways and differing intensities. Such root causes are normally a function of the economic structure, legal definitions of rights, gender relations and other elements of the ideological order. (Watts 1983)

2.5.2 Sustainable livelihoods Framework

The concept of sustainable livelihood arose during the early 1990's as a reaction to changes in general thinking about development. It was characterized by a shift from an idea of development based on economic growth and top – down processes to one centered more on participation of local communities in the development effort (Solesbury, 2003).

According to this approach, a livelihood comprises the capabilities, assets, and activities required for a means of living. It is deemed sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities, assets, and activities both now and in the future, while not undermining the natural resource base (DFID, 2000). Conceptually, livelihoods imply the means, activities, entitlements and assets by which people make a living. Assets, in this particular context, are defined as not only natural/biological (i.e., land, water, common property resources, flora, fauna), but also social (i.e., community, family, social networks, participation, empowerment), human (i.e., knowledge, creation by skills) and physical (i.e., roads, markets, clinics, schools, bridges) (FAO, 2008).

The sustainable livelihood approach strongly emphasizes on the role of poor population on development planning. It includes the views of poor people themselves about their own situations and possible solutions to challenges (Solesbury, 2003). The approach has proven useful for assessing the ability of households to withstand shocks such as epidemics or civil conflict. Livelihoods according to the SLA are contingent on three core entities: the vulnerability context, the assets of households (capitals) and the wider social institutions and processes, as outlined in the framework below.

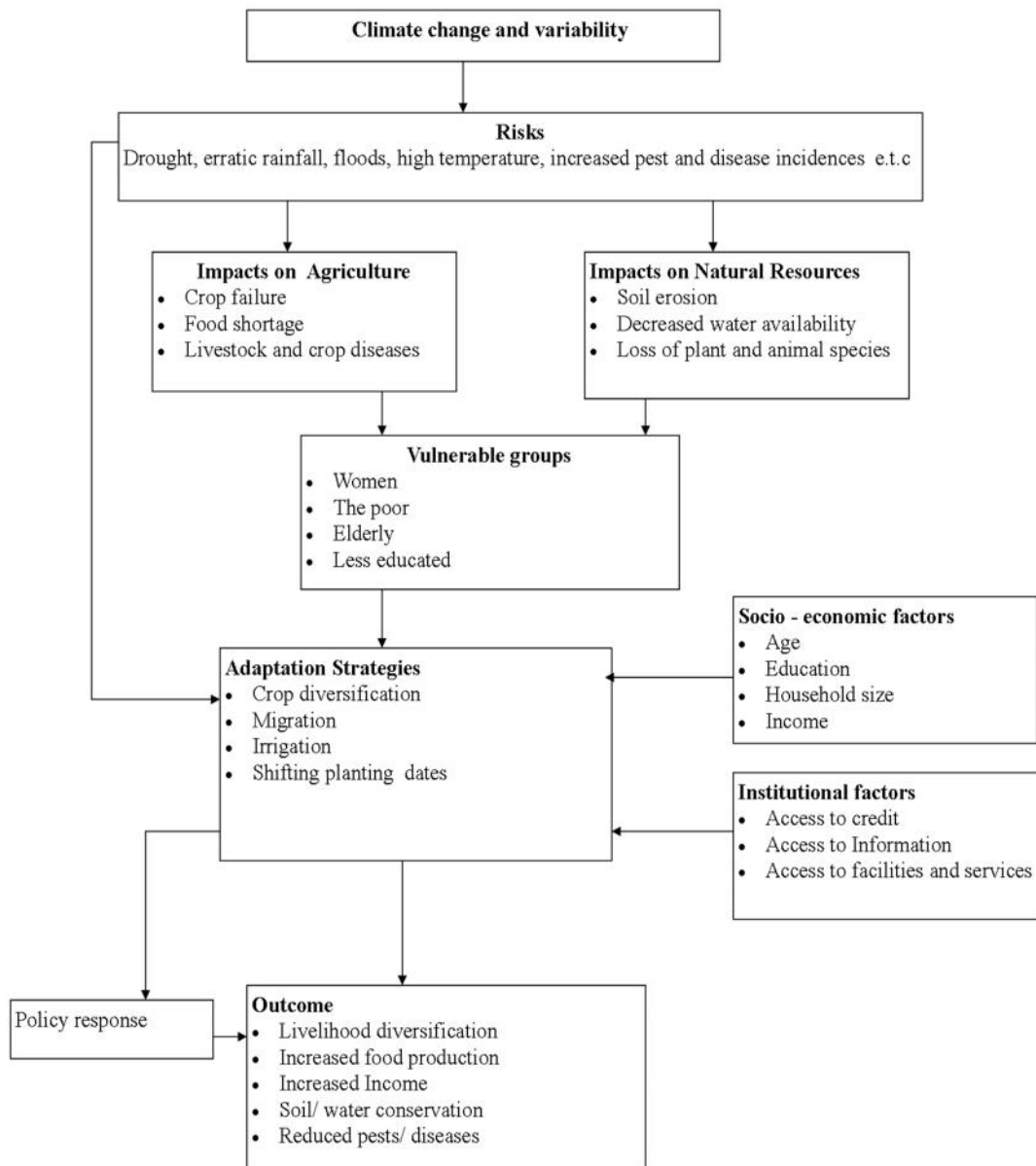


DFID'S Sustainable livelihood framework.

Source: DFID, 2000

The approach of this study is based on sustainable livelihood Approach. The Sustainable Livelihoods Approach (SLA) provides a framework for research which encapsulates many of the concepts related to the household capital accumulation relationship to a number of vulnerabilities. This framework also helps to identify which types of households are likely to be particularly vulnerable by setting the family at the centre of the analysis and by identifying the inter-relationships between shocks, vulnerabilities and coping strategies. It centers on ways of understanding the practical realities and priorities of poor men and women – what they actually do to make a living, the assets that they are able to draw on , the constraints that they face in doing this and various strategies they employ to recover or keep themselves away from shocks and stresses (DIFD,2000).

2.5.3 Conceptual Framework



Source: Adopted from (DFID, 2000) Sustainable Livelihood framework

The framework identifies the inter-relationships between shocks, vulnerabilities and adaptation strategies. It centers on ways of understanding the practical realities and priorities of local people – what they actually do to make a living, the assets that they are able to draw on and various strategies they employ to recover or keep themselves away from shocks and stresses.

The dependent variable in the empirical estimation was the choice of an adaptation option from a set of adaptation strategies while the explanatory variables for this study includes household characteristics such as education, sex, age of the household head, household size and income; institutional factors such as access to information and access to credit. Effective adaptation coupled with policy responses lead to outcome of increased food production, livelihood diversification, increased income, soil and water conservation and reduced pest and disease infections.

CHAPTER 3: STUDY AREA

3 Introduction

Uganda is located between latitudes 1.5°S to 4.5° N and longitudes 29°E to 35° E. It is bordered on the east by Kenya, on the north by South Sudan, on the west by the Democratic Republic of the Congo, on the southwest by Rwanda, and on the south by Tanzania. The southern part of the country includes a substantial portion of Lake Victoria, which is also shared by Kenya and Tanzania. Geographically, Uganda is a land-locked country that occupies 240000Km² of which open water and swamps constitute 43,941square kilometres. It is located on the East African plateau and lies almost completely within the Nile basin.

3.1 Uganda's Climate

Although all of Uganda lies within a relatively humid, equatorial climate zone, geographic features such as topography, prevailing winds, lakes, and rivers cause local variations in annual precipitation and temperature, leading to large differences and a relatively complex pattern of annual rainfall. Rainfall varies throughout the country: from rain spread throughout the year in the south, with heavy rains in the Rwenzori mountainous region in the southwest and rains falling from March to June and November/December near Entebbe on the northern shore of Lake Victoria. In the north, a dry season emerges from November to February in Gulu; the north eastern Karamoja region has the driest climate and is most susceptible to drought. The seasonality of rainfall is linked to the seasonal migration of primary humid air masses and convergence zones over Africa that shift toward a northerly location in August and to the south in January. Mean annual rainfall varies from 750 to 2000 mm between different parts of the country, shaping the geographic distribution of social and economic activities that are carried out. Mean daily temperature is 28⁰ C but temperatures below 0⁰C are experienced on higher mountain ranges like the Ruwenzori that has a permanent ice cap.

3.1.1 Uganda's Economy

Agriculture is the backbone of Ugandan economy constituting about 42% of Gross Domestic Product (GDP), over 90% of export earnings and employs about 81% of the labour force. However agricultural performance fluctuates with changes in weather conditions. Climate variability and climate change in spheres of long-term droughts and heavy rains have so far characterized reduced agriculture production and is likely to result into higher food prices, lower domestic revenues and lower export earnings among others. Productivity of Uganda's

grasslands and livestock is also dependent on climate and will therefore be affected by climate variability and climate change. There is also high uncertainty in onset and cessation of rainfall seasons. This coupled with high evaporation rates, particularly in northern Uganda affects agricultural production. The increased frequency and intensity of droughts or floods are likely to affect food security and household incomes. There is already some predicted increase in temperature by an average of 2⁰C, which would drastically reduce production of Robusta coffee that is a major export crop for Uganda therefore limiting it to highlands (Simonett, 1998). Uganda is endowed with a considerable amount of natural resources including fertile soils, minerals and vegetation. More than 40 per cent of the 25 million plus population derive economic benefits from Lake Victoria in the form of fishing, water supply, transport, hydro energy and tourism.

3.2 Study Location and size

The study was conducted in Soroti District in Uganda. The district is located in Eastern Uganda and it borders Kumi and Pallisa districts and Lake Kyoga in the South, Kaberamaido in the west and Katakwi in the North east. The district covers approximately a total land area of 2,662.5 km² of which 2,256.5 km² is land and 406 km² is water. The district lies at 1°34'60" N and 33°34'60" E, 1097 metres above sea level. It is named after its chief municipal, administrative and commercial headquarters, Soroti, where the district headquarters are located. The two predominant ethnicities in the district are the Iteso and the Kumam. The main languages spoken in the district are Ateso, Kumam and Swahili.

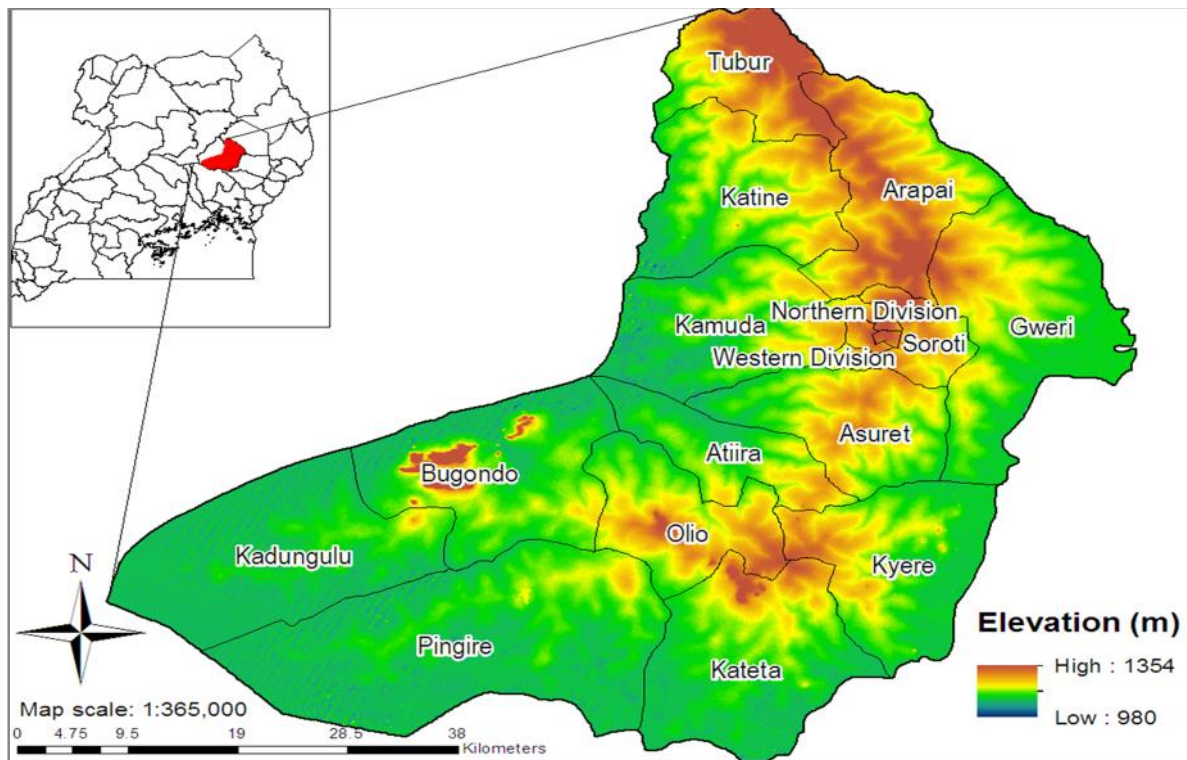


Figure 1: Map of the study area

Source: Researcher (2013)

3.2.1 Administrative set up

Soroti district is administratively divided into three (3) rural counties of Kasilo, Serere and Soroti and 1 Municipality, Soroti Municipality. There are a total of 10 Sub-counties, 41 rural parishes and 511 Local Council 1 units. The Local Councils (LC) make up the political structures i.e. LC V at the district level to the LC 1 at the village level.

Table 2 : Breakdown of Local Councils in Soroti district

Administrative units	Levels	Number of units
Village	LC I	511
Parish	LC II	41
Sub county	LC III	10
County	LC IV	4
District	LC V	1

Source: Soroti District Elections Office, 2002

3.2.2 Population

In terms of population, the district has over the years experienced a steady population growth from 219,838 in 1980 to 204,258 in 1991 and 369,789 in 2002. The recent 2002 Population and Housing Census results showed a remarkably high annual population growth rate of 5.1 %. This is one and a half times higher than the National average of 3.3 % (UBOS, 2002).

Year	Total Population	Inter – censul Pop. Growth rate
1980	219, 838	
1991	204, 258	- 0.9 (1980 – 1991)
2002	369, 789	5.1 (1991 – 2002 (period)

Source: 1980, 1991 and 2002 Uganda Population and Housing census

3.2.3 Climate

3.2.3.1 Rainfall

Soroti District experiences annual rainfall averages of 1100-1200 mm distributed between two seasons of March to July and September to November. Late November to late February or early March is traditionally the long dry season, and mid - June to late July is the short one; but this has become variable with frequent drought spells causing famine.

3.2.3.2 Temperatures

Soroti district generally records a mean annual maximum temperature of around 31.3°C and a mean minimum of around 18°C. Its extreme highest temperatures are in the month of February when it records approximately 35°C. The highest ever recorded was in February 1949 when temperatures reached 40°C. There are relatively high rates of evaporation in Soroti District as it lies near the equator. Evaporation is particularly high in the dry seasons.

3.2.3.3 Humidity

Relative humidity ranges from 66% to 83% at 0600 Greenwich Mean Time (GMT) in the morning. However, it reduces much in the afternoon (35%-57% at 1200GMT) thereby reducing chances of rainfall. During the North Eastern monsoon the area is swept by a wind that has traversed Somalia, passed between Abyssinian massif and Kenya highlands and the hills of Karamoja. The water vapour content of this wind is consequently low. The southwards passage of the inter-tropical convergence zone in October would appear to bring no more rain than is sufficient to produce a gradual falling off from the July peak. There are

relatively high rates of evaporation in Soroti District as it lies near the equator. Evaporations are particularly high in the dry seasons.

3.2.4 Geology and Soils

Most of the areas in Soroti district are underlain by rocks of the basement complex Precambrian age that include: granites, migmatites, gneiss, schists and quartzites. The soils are categorised into four major types; Serere and Amuria catenas, Metu complex and Usuk series. These are mainly of the ferrallitic type (sandy sediments and sandy loams). They are well drained and friable. Bottomlands contain widespread deposits of alluvium.

3.2.5 Vegetation

Soroti has vegetation, which can best be described as wooded savannah, grass savannah, forests and riparian vegetation. The wooded savannah mainly comprises moist *Acacia* associated with *hyparrhenia spp* and *combretum* associated with *hyparrhenia spp*. These are mainly found in the south-western part of the district i.e. Kasilo county. The riparian vegetation comprises scattered tree grasslands of *Setaria incrassate* *Hyparrhenia rufa*, *Accacia sayel* *Accacia fistula*, *Balanities aegyptica* and *Terminalia* species. Soroti also has wetlands, which cover vast areas from Apujan between Serere County in Soroti district and Ngora County in Kumi district to Gweri Sub-county in Soroti County. Further to the Northeast is semi-arid vegetation consisting of thorny shrubs.

3.2.6 Economic Activities

Most of the population in Soroti district is engaged in subsistence farming and self-employment. A few people are employed in formal jobs as civil servants and non-governmental organizations. The farming system is predominantly annual cropping and cattle Teso system. Accounting for 76% of the total population, subsistence agriculture is the major source of livelihood for Soroti district. The commonly grown crops include food crops and cash crops. The major food crops grown are cassava, sorghum, sweet potatoes, cow peas, groundnuts, millet, green gram, simsim, maize, beans, peas and rice. It is also evident that some traditional food crops have been transformed to cash crops. This is because of high demand and to some extent having recommendable market value. However, initially cotton was taken as the sole cash crop but now other food crops have been grown to provide cash. These include millet, rice, sweet potatoes, cow peas, green gram, cassava and sorghum. Some vegetables and fruits are equally produced for cash, i.e. pineapple, oranges, mangoes,

tomatoes, cabbage, onions, yams, sugar cane and are commonly grown along the wetland edges, especially during dry season.

3.2.7 Road Network

Given that road transport is the most dominant in the country, road transport infrastructure services are a crucial input for socio-economic development of a country. They constitute the threshold for sustained growth in all sectors, and provide linkages to most of the necessary amenities for supporting higher living standards. The road network in Soroti district is predominantly murrum. The only bitumen road sections in the district consist approximately of 15 km of the main Soroti-Mbale road; 45km of Soroti - Lira road; and approximately 15 km of town/street roads within the centre of the Municipality and the road section that extends about 14 km northwards to the railway station. Major Murrum trunk roads are: Soroti-Moroto; Soroti-Mbale via Brooks corner; and Soroti-Serere -Bugondo roads.

3.2.8 Migration

The district has always experienced large immigration and emigration from the neighbouring district due to insurgency experienced from 1987 – 1991, The Lord's Resistance Army (LRA) incursion in 2003-2005 and the recent floods in 2007. However, seasonal immigrations also continue to occur when the Karamojong nomads cross into the relatively wetter parts of the district in search of water and pasture. This normally occurs from the November to March season. The major districts of immigration are Katakwi, Amuria, Kaberamaido and partly from Kumi in search of Land for settlement.

CHAPTER 4: RESEARCH METHODOLOGY

4 Introduction

This chapter presents the study design. It also covers sample selection method and the sample size. Data collection methods such as household questionnaires, focused group discussion, field observation and key informant interviews are explained. Limitations of the study are also outlined in this chapter.

4.1 Study Design

Since the emphasis of this study was to undertake an intensive examination of impacts of climate change and variability on livelihoods, vulnerability and adaptive strategies within a specific location, a case study design was used. Case study design is important in gathering data through observing people's actions and situations and exploring the individuals' attitudes, preferences and behaviors. In case study research, exploratory questions, 'what' and 'how', are useful in harnessing detailed and valuable insights and understanding of the topic which cannot not be achieved by a survey (Bryman, 2008). The case study strategy was both quantitative and qualitative.

4.2 Sample size and Sampling procedure

The study adopted Cochran equation to determine the sample size. For populations that are large, Godden (2004) developed the Equation 1 to yield a representative sample for proportions.

The formula is as follows:-

$$n_0 = \frac{z^2 p (1 - p)}{e^2}$$

Where n = Sample size

Z = z Value (1.96 for 95% confidence level)

P = Estimated proportion of population (assumed to be 40% or 0.4)

e = Margin of error (assumed to be 0.07)

$$\begin{aligned} \text{Therefore } n &= \frac{1.96 * 1.96 * 0.4(1 - 0.4)}{0.0049} \\ &= 180 \end{aligned}$$

A multi-stage random sampling procedure was adopted in order to select the participating villages and households for the interviews. The 10 Sub - counties within the district were grouped in terms of high, medium and low agricultural productivity. From each group, one Sub - county was randomly selected making a total of three Sub- counties. At the sub-county level, two parishes were also randomly selected making a total of 6 parishes. A total of 9 villages were then randomly selected from the 6 parishes. At village level, lists of all households were obtained from local councils (village elders) and systematic random sampling was used to select 20 households in each village. Overall, 180 households were selected for the interview.

4.3 Data Sources

4.3.1 Primary Data

a) Household Survey

A formal survey was conducted using a standard questionnaire. The questionnaire was administered to the household heads and was designed to capture information on family characteristics (educational and marital status, family size, age, sex, major source of income) as well as other parameters such as local perception of climate change, their coping methods to changing/ unreliable onset of rains; rainfall intensity, quantity and seasonal distribution. A sample of 180 respondents was interviewed.

The researcher, together with extension officers from the Soroti district agricultural office conducted the interviews. The local extension officers helped in collecting data because they had a better understanding of the area and the local language. The interviewers explained to the respondents the purpose of the survey and the importance of their participation and co-operation during the interviews. Interviews were conducted face-to-face with household heads (either male heads or female heads) in their homes or with an adult that was at home in the absence of household heads.

b) Focused Group Discussion (FGD)

Discussions were carried out with local people to get information about the past and present condition of climate, impacts and adaptation strategies. A total of three focused group discussions were carried out in Katine, Soroti and Gweri sub counties respectively. Each focused group consisted of five men, five women and five youths. During the discussions, timeline and historical profile/ recall methods were used in order to identify climate extreme

events and their variability over time, frequency and intensity. FGD was used to validate and triangulate the responses that came out of household survey.

c) Field observation

Field observations were carried out a number of times. During field visit, observations were made on impacts of climate variability and change on livelihood sources. Observations were carried out in the respondents' homes, farms and the surrounding environments and photographs taken. These observations were utilized to triangulate the information gathered from the other sources

d) Key Informants Interview

Additional information was gathered from government staffs i.e. District Environment Officer and the District Agricultural Officer. This information was used to cross check the views of respondents. The interview was focused on climate pattern, vulnerable groups, impacts of climate variability and change and possible adaptation measures.

4.3.2 Secondary Data

a) Climatic data

Temperature and rainfall data obtained from Soroti meteorological station was used to analyze the trends in climate change and variability. Rainfall data was available for the years 1961 to 2011 while temperature data was available for the years 1971 to 2007.

b) Socio economic and other data

Socio – economic and other secondary data was obtained from relevant publications like books, journals, internet papers and research publications. Review of literature was done in libraries and concerned agencies such as National Agricultural Research Organization (Uganda) and, IGAD Climate prediction and Application Center (Kenya).

4.4 Data Analysis

All the quantitative data were entered in the Statistical Package for Social Science (SPSS) 16 and Microsoft-Excel 2007 Program. The results were then represented in the form of tables, graphs, and charts. A trend analysis of rainfall and temperature data obtained from Soroti meteorological station was done using the Ms-Excel 2007 and results presented in the form of rainfall and temperature curves and graphs. The conceptual framework provided

by the third assessment report of the IPCC was used to analyze. The report indicates that vulnerability is a function of the character, magnitude and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity (IPCC, 2001).

$$V = f(\textit{exposure, sensitivity and adaptive capacity})$$

Major climatic hazards of the study area were identified on the basis of exposure of people's livelihood assets like human, social, physical, biological, financial capital to climate change and variability from focused group discussions and from the key informants. They were then ranked on the basis of their exposure and sensitivity on five capitals and the adaptive capacity of the households to climatic shocks. Then vulnerability was then assessed as a function of exposure, sensitivity and adaptive capacity. Pearson's Chi – square analysis was used in testing the hypotheses.

The equation is specified as follows:

$$x^2 = \sum \frac{(o - e)^2}{e}$$

Where x^2 = Chi - square statistic

o = Observed values

e = Expected values

4.5 Limitations and challenges

There were a number of limitations and challenges regarding the accomplishment of this study. Due to a language barrier, the researcher could not interact with the locals directly. In that regard, the researcher used interpreters when conducting focused group discussions.

Another challenge encountered during this study was the paucity of climatic data for the sub region especially the temperature data. The temperature data had several gaps where certain months had no data recorded. However long term averages were calculated and used to fill the gaps.

CHAPTER 5: RESULTS AND DISCUSSION

5 Introduction

This section presents the key findings of the study. The section is divided into five sub-sections. The first sub-section provides the socio-economic profile of the sampled households. The second sub-section deals with analysis of perceptions towards climate change and variability and trend analysis.

The third part shows the impact of climate change on the livelihood sources, while the fourth part presents the vulnerable groups within the district. The last part highlights the major coping and adaptation strategies that the locals apply to deal with the impacts of climate change and variability and constraints that hinder effective adaptation based on the data gathered during the field study.

5.1 Socio-economic profile of sampled households

The socio – economic profile of the community refers to the attributes of sex, age, levels of education, employment status, income, household sizes, and main source of livelihood .These factors play an important role in determining the vulnerability and attitude of the respondents towards adaptation to climate change and variability

5.1.1 Sex and Age of the household head

Gender and age are important factors in determining vulnerability and choice of adaptation strategies since climate change and variability affects men and women of various ages differently, given their distinguished roles and responsibilities at the household and community levels (Aguilar, 2009). The study found out that 78% of the household heads are male while 22% are female. In terms of age, 33% of the respondents are aged between 15 – 35 years, 35% are aged between 36 – 55 years, 22% are aged between 55 – 64 years and 10% are aged between 64 years and above (figure 2).

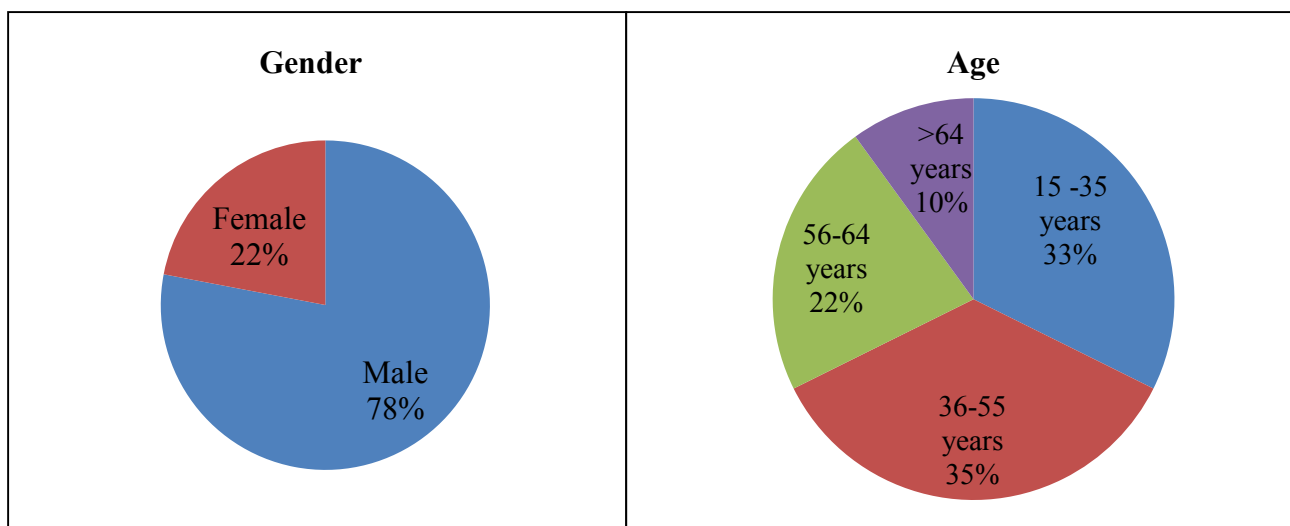


Figure 2: Sex and age of the household head

Source: Field data, 2013

The results indicate that most household heads in the district are men. This means that men are mostly responsible for making most decisions regarding the welfare of their households as well as ways of coping and /or adapting to climate change and variability.

A study conducted by Asfaw and Admassie (2004) in Ethiopia suggested that male headed households have a higher probability of getting information about new farming technologies and also undertakes more risky ventures than female headed households. Tenge and Hella (2004), also points out in their study that female headed households are less likely to adopt water and soil conservation measures since women may have limited access to information, land, and other resources due to traditional social barriers. Given access to appropriate technology and information, there is a likelihood of most households in this study adopting appropriate coping and adaptation measures thereby reducing their vulnerability to impacts of climate variability.

Age of the respondents may also have an influence on vulnerability and choice of adaptation measures. Croppenstedt *et al.*, (2003) argues that age may affect the farmer's choice of adaptation in two ways. On one hand it may negatively influence the decision to adopt new technologies simply because older farmers are more risk-averse and less likely to be flexible than younger farmers. On the other hand, age may positively influence the decision to adopt because older farmers have more experience in farming and are better able to assess the characteristics of a new technology than younger farmers.

The study shows the proportion of the elderly population within the district is smaller (10%) as compared to the younger population. This means vulnerability in terms of age is lower within the district since the younger population is more likely to cope with the effects of climatic extremes as compared to the elderly.

5.1.2 Education level of household head

Education plays an important role in individual's personality development and also has an important role in nation building as there is strong relationship between education and economic development. The results show that 13% of the respondents are illiterate, 65% have primary school education, 15% have secondary education, 3% have higher education (A levels) and only 4% have acquired tertiary education (figure 3).

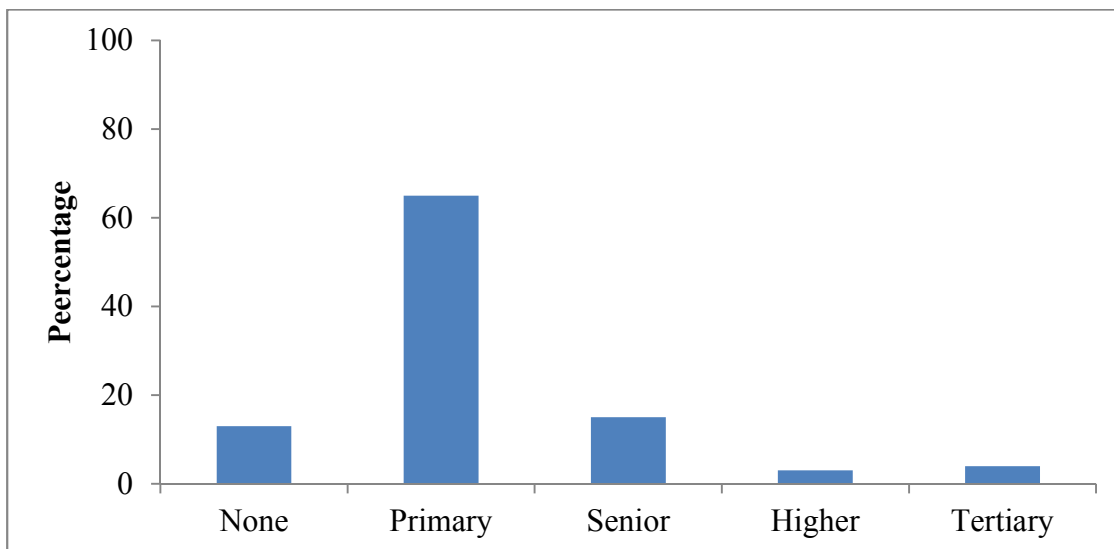


Figure 3: Level of education of household head

Source: Field data, 2013

It is evident from the results that majority of the household heads have low levels of education (figure 3). The likely cause of this low education status is poor economic condition hence people tend to abandon education to seek for means of satisfying their needs. It was also observed that secondary schools are very far away from the villages and students have to cover long distances to reach to the schools.

According to Nabikolo *et al* (2012), those with formal education are better able to respond to climatic shocks and thereby reducing their vulnerability. Maddison (2007) also emphasises that educated and experienced farmers are expected to have more knowledge and information about climate variability and change and adaptation measures that are necessary to respond to

climate challenges. Norris and Batie (1987) assert that a farmer with higher level of education is more likely to have access to information on improved technologies for higher productivity.

The local's low education levels within the district could enhance their vulnerability to impacts of climate change and variability limiting their knowledge on climate variability and high technology adaptation measures

5.1.3 Employment Status and Income levels

Employment and income are other important factors influencing decision to adapt to climate change and variability. Table 3 indicates that most respondents (77.4%) are engaged in some form of employment (i.e. full time, part time or self-employed). A significant number of the respondents (19.3%) are unemployed. Figure 4 indicates that a majority (33.3%) of the respondents earn below 100,000 UG shillings (3400Ksh.) whereas the least number (3.3%) earn above 500, 000 UG shillings (16, 500 Ksh.). A significant number (38.3%) are not earning any income.

Table 3: Showing employment status of the household heads

Employment status	frequency	percentage
Full-time work	18	10.5
Part-time work	55	30.4
Self employed	66	36.5
Homemaker	1	0.6
Retired	3	1.7
Student	2	1.1
Unemployed	35	19.3
Total	180	100.0

Source: Field data, 2013

Income earnings

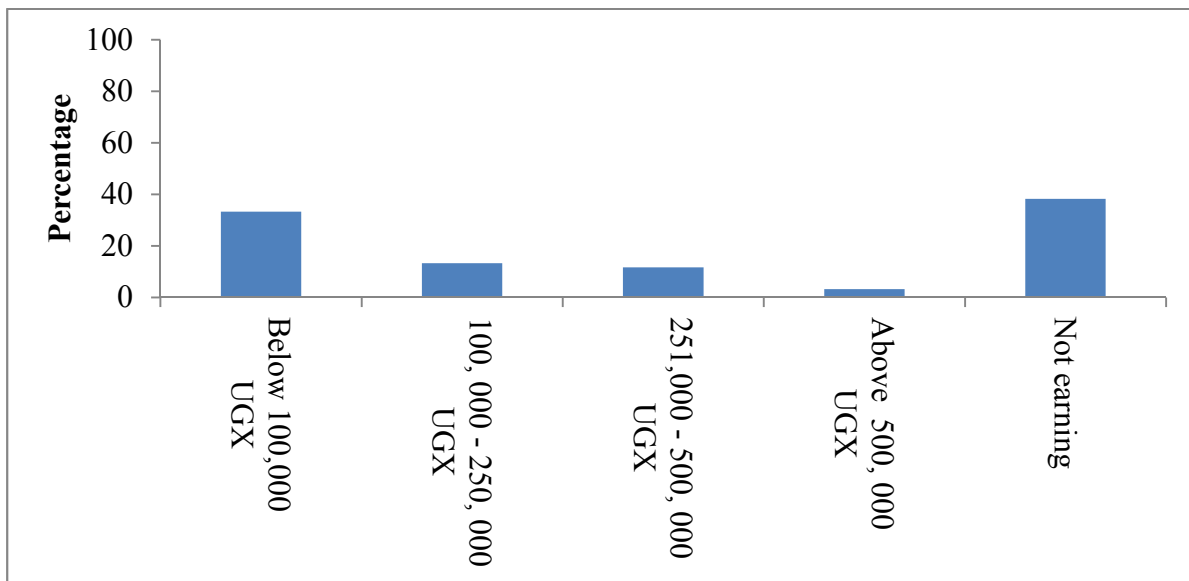


Figure 4: Income levels

Source: Field data, 2013

There is evidence of low employment and income levels in the district. Even those engaged in some form of employment have low income levels (figure 4). This indicates high levels of vulnerability in the entire district. Anley *et al.* (2007) argues that improving levels of education, income and employment is important in reducing vulnerability to climate change and stimulating local participation in various adaptation measures and natural resource management initiatives. Those with better income are considered to be less vulnerable to climate variability and change impacts because they are able to use their resources to cope with climatic extremes.

5.1.4 Household size

Figure 5 below indicates that most households have an average of 6 – 10 members. This is slightly above the national average household size of 5 persons per household (UBOS, 2009)

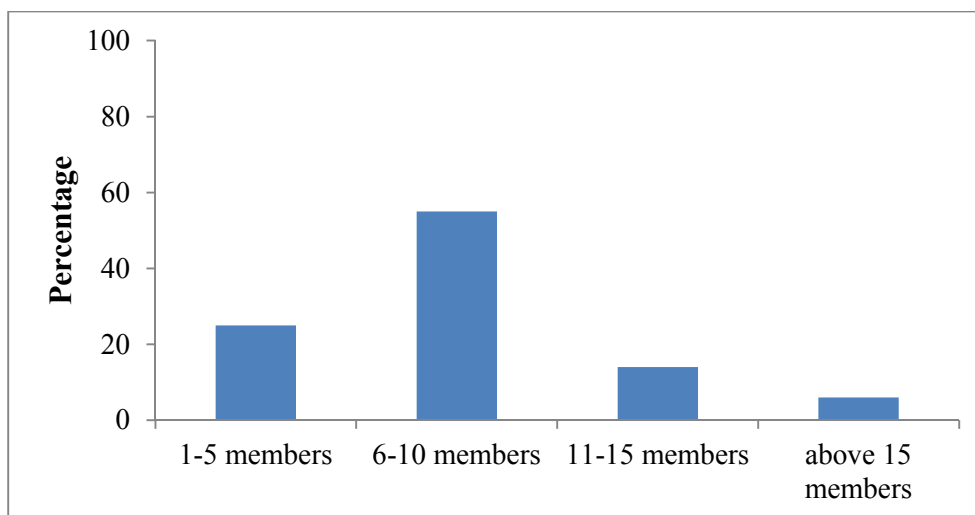


Figure 5: Size of the households

Source: Field data, 2013

Given the low levels of education (figure 3) and low income status (figure 4), vulnerability to climate change and variability in the district is likely to be heightened due to consumption pressure imposed by large families. However, Yirga (2007) observes large families may be able to divert part of the labor force to off-farm activities in an attempt to earn income in order to ease the consumption pressure imposed by a large family. He also argues that a large family has a higher labor endowment, which is likely to enable it to accomplish various agricultural tasks. Croppenstedt *et al.* (2003), on the other hand asserts that households with a larger pool of labor are more likely to adopt an agricultural technology and use it more intensively because they have fewer labor shortages at peak times. Given appropriate support, households within the district are therefore well able to utilize their large labour pool in farm and non - farm activities to earn extra income thereby enabling them to cope with climatic extremes.

5.1.5 Main House construction materials

Construction materials for the houses also help in determining vulnerability to climatic extremes. Most of the main houses in Soroti have walls that are made of unbaked bricks (48.6%) and grass-thatched roofs (81.8%) (Table 4).

Table 4: Main house construction materials

Construction Materials		Frequency	Percent (%)
Type of walls	Mud & Wattle	63	34.8
	Wood panel	1	0.6
	Unbaked Bricks	88	48.6
	Stones	1	0.6
	Baked bricks	27	15.5
	Total	180	100.0
Type of roof	Grass thatched	148	81.8
	Iron sheet	31	17.7
	Tiled	1	0.6
	Total	180	100.0

Source: Field data, 2013

The condition of the main house increases the vulnerability levels of the locals to extreme climatic shocks. Since these houses are constructed using temporary materials such as unbaked bricks and grass, they can be easily swept away by extreme weather events such as floods

5.1.6 Access to facilities and services

Ease of access to credit, hospitals, markets and other services could reduce vulnerability significantly. Results indicate that 100% of the respondents interviewed have no access to television while a majority (69.1%) have access to radio. 100% of the respondents have no access to electricity and only 27.6 % have access to credit (table 5). Table 6 shows that most of the respondents can access certain facilities within a short time for instance 59.1% can access the nearest vehicle station in less than an hour, 46.1% can access the nearest health center in less than an hour and 38.7% can access the nearest market in less than an hour

Table 5: Access to facilities and services

Facility / Service		Frequency	Percent
Access to television	No	180	100.0
Access to Radio	Yes	124	69.1
	No	56	30.9
	Total	180	100.0
Access to Electricity	No	180	100.0
Access to Credit	Yes	50	27.6
	No	130	72.4
	Total	180	100.0

Table 6: Ease of access to various facilities

	Time taken	Frequency	Percent(%)
Time taken to reach nearest vehicle station	Less than one hour	107	59.1
	One hour	39	21.5
	More than one hour	34	19.3
	Total	180	100.0
Time taken to reach nearest health center	Less than one hour	83	46.1
	One hour	36	20.0
	More than one hour	61	33.9
	Total	180	100.0
Time taken to reach nearest market	Less than one hour	70	38.7
	One hour	42	23.2
	More than one hour	68	38.1
	Total	180	100.0

Source: Field data, 2013

Access to facilities such as radio and television could increase access to information required to make the decision to adapt to climate change. Various studies in developing countries indicate a strong positive relationship between access to information and adaptation behaviour of farmers (Yirga, 2007). Access to information through extension services also increases the likelihood of adapting to climate change (Nhemachena *et al.*, 2007). Ease of access to facilities such as, vehicle stations, hospitals and markets can help reduce vulnerability to climatic shocks

5.1.7 Main source of livelihood

Majority of the respondents (91%) depend on farming as their main source of livelihood (figure 6). Most respondents (73.9%) practice mixed farming. The livestock and crops grown are both for subsistence and commercial purposes (Table 6 and 7)

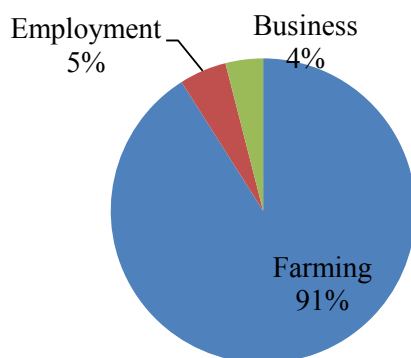


Figure 6: Sources of livelihoods

Source: Field data, 2013

Table 7: Type of farming practiced

Description of farming		Frequency	Percent
Type of farming	Crop farming only	41	22.8
	Livestock rearing / herding only	6	3.3
	Mixed farming (Crop & Livestock production)	133	73.9
	Total	180	100.0

Table 8: Type of agriculture practiced

Type of agriculture practiced	Rain-fed	175	97.2
	Irrigated	1	0.6
	Not farming	4	2.2
	Total	180	100.0
Reason for doing farming	Subsistence	36	20
	Commercial	0	0.0
	Both subsistence & commercial	140	77.8
	N/A	4	2.2
	Total	180	100.0

Source: Field data, 2013

Results from figure 6 and table 8 indicate that the main source of livelihood in Soroti district is rain fed agriculture. However, rain fed agriculture is highly vulnerable to climate change and variability (Deressa *et al.*, 2000; Eriksen, 2000; FAO, 2008). It is highly affected by unseasonal and irregular rainfall patterns which in turn negatively affect crop and livestock farming. The impacts can include crop failure and lack of feeds for cattle, animal diseases and lack of water among others. These impacts therefore threaten the people’s main source of livelihood and increase the risk of food insecurity. The extended dry spell in 2013 March – April – May (MAM) season for instance led to serious crop failure within the district

5.2 PERCEPTION AND TREND OF CLIMATE CHANGE AND VARIABILITY

5.2.1 Respondent’s Perception of climate variability and change

Local knowledge and perception about climate change is of great importance in enabling the locals to cope with the negative impacts of climate and variability. Results in table 9 below shows that most respondents (97.8%) had noticed changes in climate and its variables over the years. Most respondents reported that the rainfall on-set was late (72.3%) while the biggest fraction claimed that rainfall amounts were light (66.1%). More so, slightly less than a half of the respondents reported that rainfall seasonal distribution was heavier in the second season (48.6%) whereas the highest proportion mentioned that cessation was early (64.4%). Most of the respondents (70.7%) also felt that the temperatures were on an increasing trend.

Table 9 : Perception and Knowledge of climate change and variability

		Frequency	Percent
Respondents who have observed changes in weather patterns over the last 5-30 years	Yes	177	97.8
	No	3	2.2
	Total	180	100.0
Changes observed (Rainfall)			
Rainfall on-set	Early	18	10.2
	Normal	3	1.7
	Late	128	72.3
	Variable	28	15.8
	Total	177	100.0

Rainfall amounts	Light	117	66.1
	Normal	6	3.4
	High	9	5.1
	Variable	45	25.4
	Total	177	100.0
Rainfall seasonal distributions	Normal	7	4.0
	Heavier in the first season	32	18.1
	Heavier in the second season	86	48.6
	Drought interspersed within seasons	23	13.0
	Variable	29	16.4
	Total	177	100.0
Cessation (end of rainy season)	Early	113	64.4
	Normal	9	5.2
	Late	55	30.5
	Total	177	100.0

Source: Field data, 2013

Temperature	Lower	15	8.6
	Moderate	24	13.2
	Higher	124	70.7
	Variable	14	7.5
	Total	177	100.0

Source: Field data, 2013

The results shows that the respondents are aware of climate change and variability and have noticed some changes in the weather patterns over the last 5 – 30 years. The variation in rainfall amounts and increase in temperatures was found to have a significant negative effect on farming which is the main source of livelihood. Results from three different focus group discussions also indicated that there has been a significant change in climate over the past years. There was a consensus between both genders that rainfall patterns have been erratic over the last three decades based on their local knowledge.

One participant argued that, *‘the variability in rainfall pattern makes it increasingly difficult to plan land preparation and planting times.* Another participant also argued

that “dry spells have become more frequent and severe and the rains start late and end early sometimes with extended dry spell in between a season. He further stated that “this unpredictable rainfall pattern led to serious crop failure in the first season of the year 2013. “

5.2.2 Climate trend Analysis.

Rainfall Analysis

The rainfall trend analysis shows some significant changes in rainfall patterns. The average annual rainfall over the past 50 years (1961 – 2011) shows a decreasing trend in rainfall amounts in Soroti district. The analysis also shows that there has been a significant variation of rainfall within the district in last 50 years (1961 – 2011), with a considerable increase in the years 1975, 1978, 1991 1996 and 2000 and a significant decline in the years 1980, 1987, 1993, 2004 and 2011. (Figure 7)

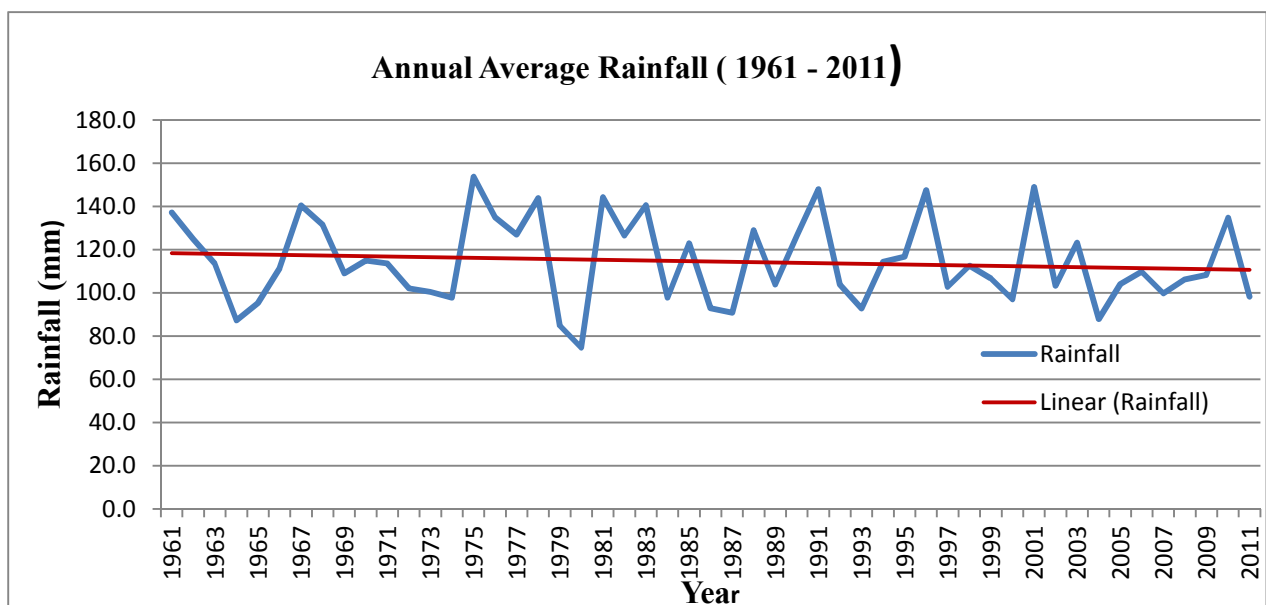


Figure 7: Annual average rainfall from Soroti meteorological station (1961 - 2011)

Source: Soroti meteorological station, 2013

The respondents’ perceptions are consistent with the actual climatic data. Rainfall data shows that the average annual rainfall is on the decrease in Soroti and the potential crop growing period is also shrinking which is well collaborated by an overwhelming majority of respondents (66.1%) reporting that the rainfall amounts are light (Table 9). The variations in the rainfall pattern are very significant for the locals because they directly dependent upon the rain fed agricultural practices and any changes in rainfall will hamper crop production.

Decline in the amount of rainfall could lead to crop failure while excessive rainfall amount could cause flooding and soil erosion.

Annual Average Rainfall in decades

An analysis of the annual rainfall averages for five decades (figure 8) shows that the highest rainfall amounts occurred in 1961 – 1970 and 1981 – 1990 decades and the lowest rainfall amounts was experienced in 1971 – 1980 and 2001 – 2010 decades. There is also a notable reduction in the amount of rainfall in the last decade (2001 – 2010)

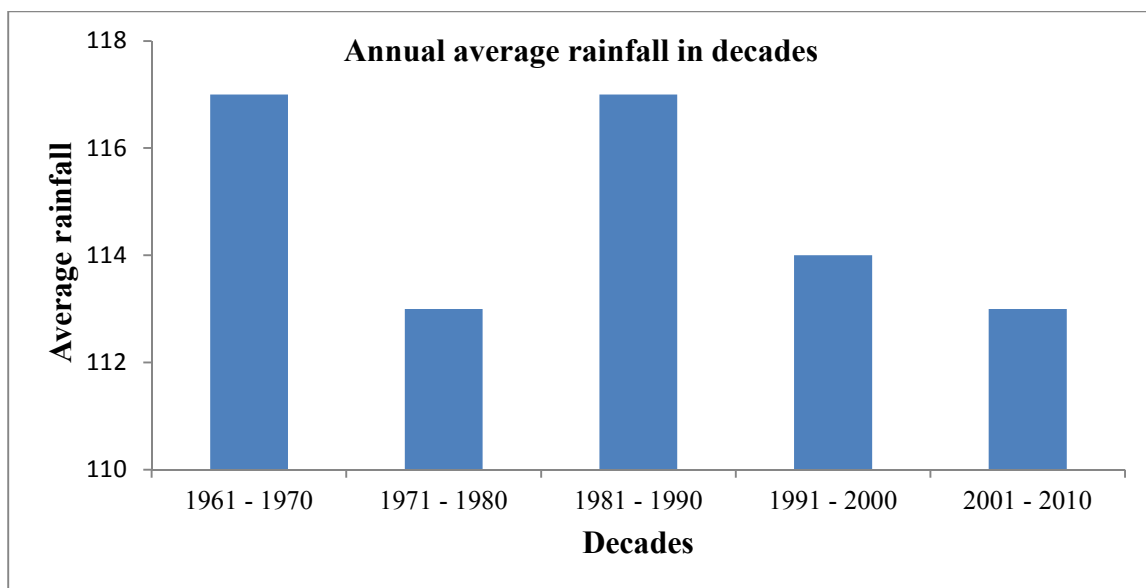


Figure 8: Annual Average rainfall in decades.

Source: Soroti meteorological station, 2013

Temperature analysis

The temperature data for Soroti meteorological data for the year 1971 – 2007 was obtained and analysed. Figure 9 and 10 indicates some visible changes in temperature for a period of 36 years (1971 – 2007). There is a significant increase in both the maximum and minimum temperatures over the years. This increase in temperature could hamper plant growth and lead to a significant decline in available water resource

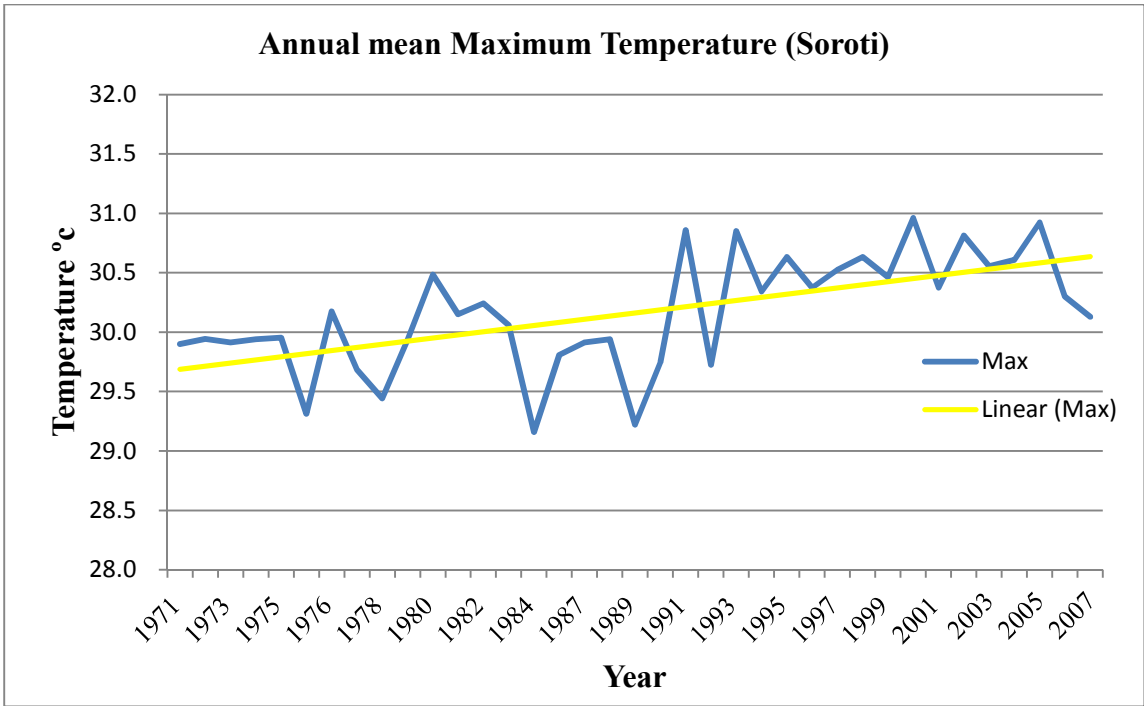


Figure 9: Annual mean maximum temperatures (1971 – 2007)

Source: Soroti meteorological station, 2013

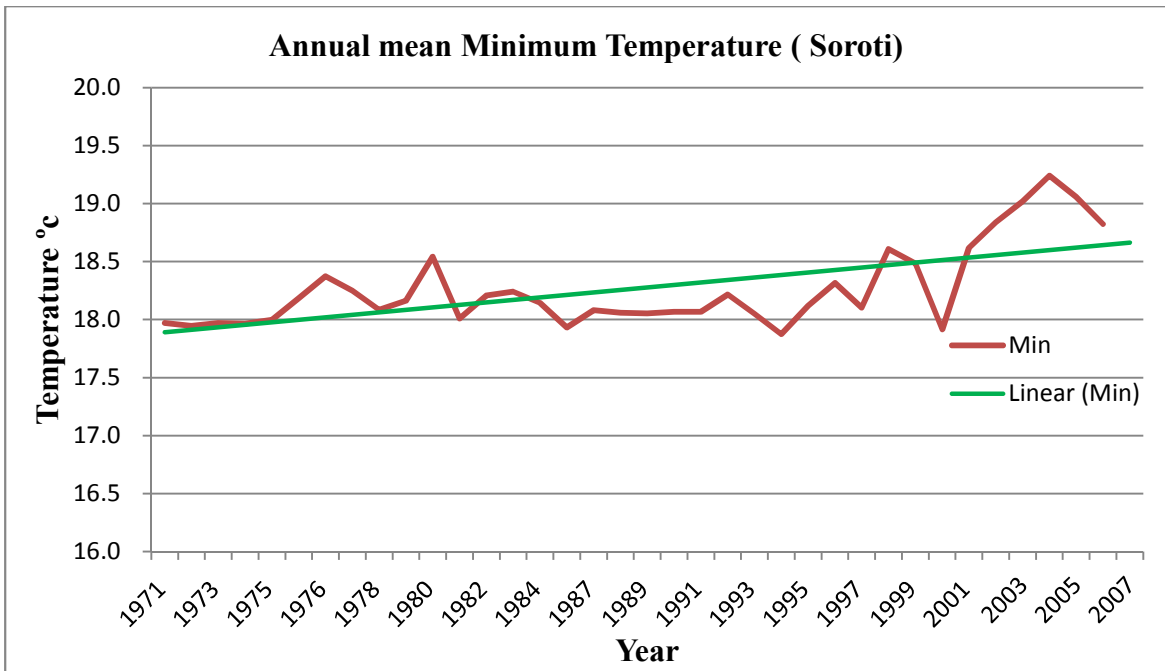


Figure 10: Annual mean Minimum temperature (1971 – 2007)

Source: Soroti Meteorological station, 2013

Average maximum temperature in decades

Figure 11 illustrates the increasing trend of temperatures in decades. Average decade temperature calculated for 1971-1980, 1981-1990 and 1991 - 2000 provides 29.8°, 29.9° and 30.6° respectively with the highest increase in the last decade.

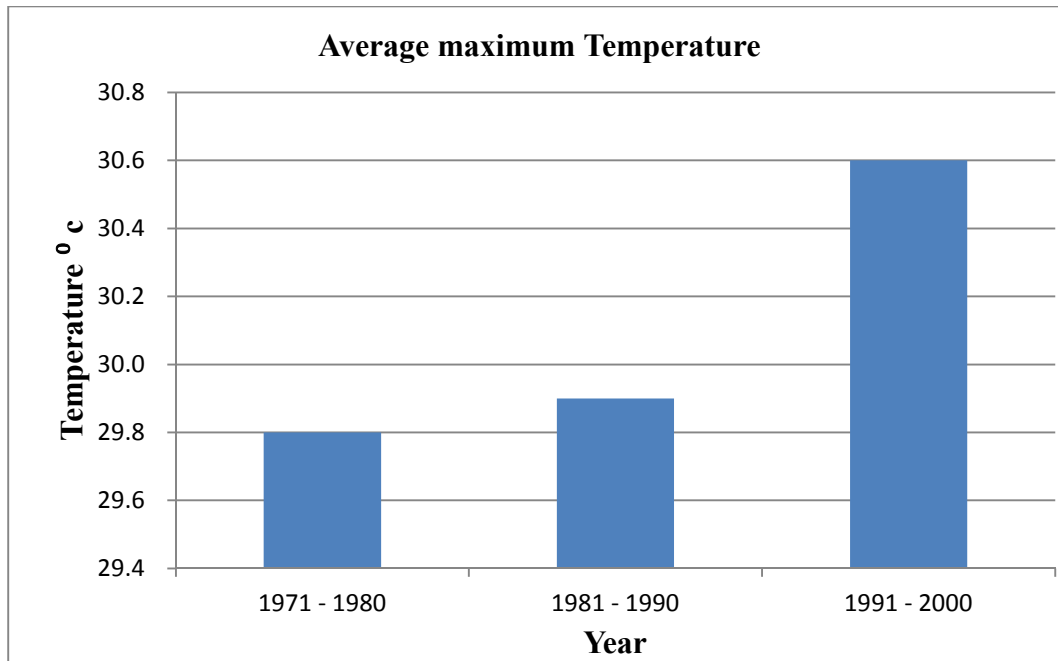


Figure 11: Average maximum temperatures in decades

Source: Soroti meteorological station, 2013

Figure 9, 10 and 11 shows variability in the temperature of the area. The general trend suggests a gradual increase in the aggregate mean annual temperatures from 1971 to 2007. From a low of 29.8 °C in 1971 – 1980 decade, maximum temperatures have increased to 30.6°C in the 1991 – 2000 decade (figure 11). This shows an increase of 0.8°C between the 1981 – 1990 and 1990 - 2000 decades. This increase could have an enormous effect on agriculture due to increases in evaporation and evapo - transpiration rates thereby leading to a reduction in soil moisture.

A study conducted in Burkina Faso by Ouedraogo *et al.* (2006) found out that a 1°C increase in temperature reduces farm revenue by 19.9 US\$/ha, while if precipitation increases by 1 mm/month, net revenue increases by 2.7 US\$/h using a standard Ricardian model. This shows that agriculture is very sensitive to precipitation in Burkina Faso. In Ethiopia, the results are not different. A study by Deressa (2006) reveals that net farm revenue would fall in summer and winter if temperature increases whereas increase in precipitation during spring will increase net farm revenue.

5.2.3 Type of climatic shock that is the main concern

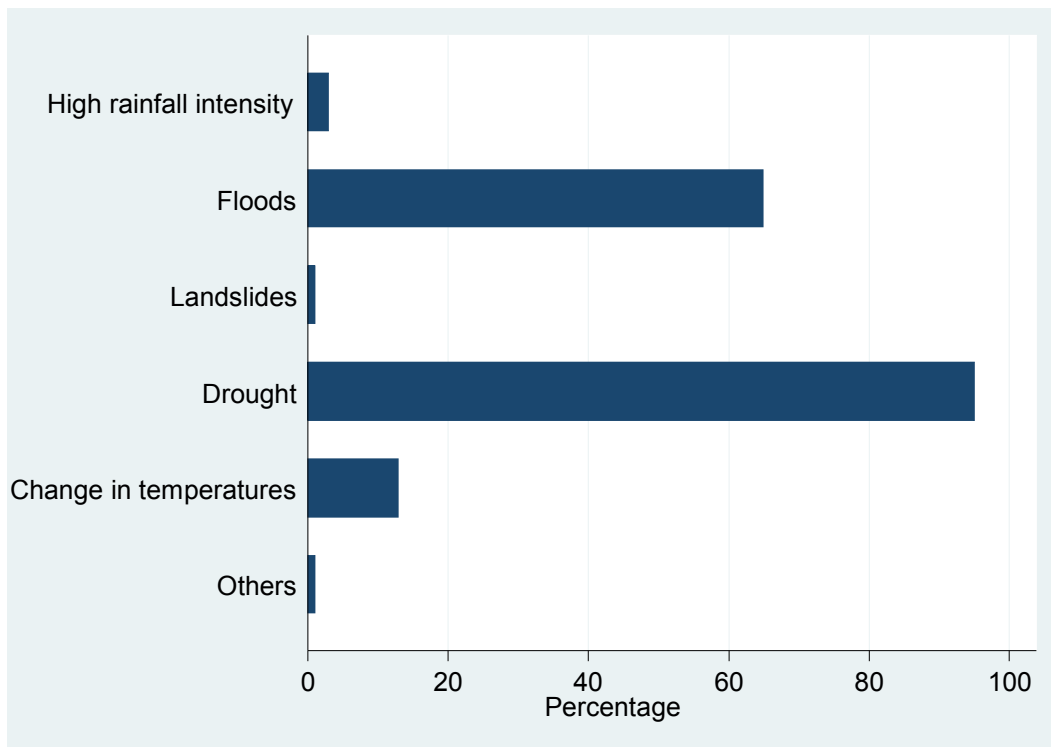


Figure 12: shows the type of climatic shock that is of main concern to the residents

Drought was stated as the most frequent climatic shock of main concern in Soroti district followed by floods.

Hypothesis 1: There is no significant variation in climatic extremes such as floods and drought across different villages in Soroti district

Drought, flood, land degradation and ecosystem degradation hotspots within Soroti district were identified by testing the relationship between village of residence and type of climatic shock experienced at 95% confidence level as shown in the table below:

Table 10 Percentage distribution of major climatic shock by village of residence

Village name		Type of climatic shock that is your main concern						Total
		High rainfall intensity	Floods	Landslides	Drought	Change in temperatures	Others	
Aputon	Count	2	3	0	9	5	0	19
	% within Village	10.5	15.8	0.0	47.4	26.3	0.0	100.0
Ojwiny	Count	0	4	0	4	1	1	10
	% within Village	0.0	40.0	0.0	40.0	10.0	10.0	100.0
Agora	Count	0	12	0	18	1	0	31
	% within Village	0.0	38.7	0.0	58.1	3.2	0.0	100.0
Amen A	Count	1	9	0	15	5	0	30
	% within Village	3.3	30.0	0.0	50.0	16.7	0.0	100.0
Omirio	Count	0	8	1	20	0	0	29
	% within Village	0.0	27.6	3.4	69.0	0.0	0.0	100.0
Otidonga	Count	0	6	0	8	0	0	14
	% within Village	0.0	42.9	0.0	57.1	0.0	0.0	100.0
Asinge	Count	0	10	0	5	0	0	15
	% within Village	0.0	66.7	0.0	33.3	0.0	0.0	100.0
Olelai	Count	0	6	0	4	0	0	10
	% within Village	0.0	60.0	0.0	40.0	0.0	0.0	100.0
Gweri	Count	0	7	0	12	1	0	20
	% within Village	0.0	35.0	0.0	60.0	5.0	0.0	100.0
Total	Count	3	65	1	95	13	1	178
	% within Village	1.7	36.5	0.6	53.4	7.3	0.6	100.0
<i>Test of hypothesis/significance</i>		<i>Chi-square=64.673 Degrees of freedom=40 p-value=0.008</i>						

A significant relationship was established between type of climatic shock experienced and village name of residence ($p < 0.05$).

High rainfall intensity was witnessed by in Aputon as compared to other villages (10.5%).

Floods had been witnessed most in Asinge village as compared to the others (66.7%).

Drought was found to be common in Omirio as compared to other villages (69%).

Changes in temperatures were experienced most in Aputon in comparison with other villages (26.3%). Landslides had not been experienced by most of the locals in the district.

5.3 IMPACT OF CLIMATE CHANGE ON LIVELIHOODS

The evidence gathered during respondent's interview suggests that climate change and variability has been frequently imposing various challenges on the livelihoods of the local people and consequently affecting the society's socio-economic activity. The results shows that the main impact of climate change and variability on crop farming in Soroti district is crop damage (56.1%) while the main impact on livestock farming is lack of animal feed (28.9%) (Table 9)

In terms of fishing, low fish catches were reported by the biggest fraction of households as the main impact of climate change and variability (41.1%). Majority of the respondents stated that decreased water availability was the main impact of climate change on water resources (73.9%) Decline in soil fertility was reported by the biggest fraction of respondents as the main impact of climate change on land resources (38.9%) (Table 10 and 11)

Table 11 : Impacts of climate change and variability on Agriculture

Livelihood source	Impact	Frequency	Percent
Crop farming	Crop failure	72	40
	Crop damage	101	56.1
	Pest infestation	4	2.2
	Others	1	0.6
	N/A	2	1.1
	Total	180	100.0
Livestock farming	Lack of feeds	52	28.9
	Water shortage	34	18.9
	Low milk production	4	2.2
	Small grazing areas	24	13.3
	Disease prevalence	22	12.2
	Death of livestock	10	5.6
	Others (n/a)	34	18.9
	Total	180	100.0

Source: Field data, 2013

Table 12: Impacts of climate change on natural resources

Natural resource	Impact	Frequency	Percentage
Fishing	Low fish catches	74	41.1
	High fish catches	6	3.3
	Low fish weight	23	12.8
	Decreased fish varieties	13	7.2
	Increased fish variety	1	0.6
	Low volumes of water	15	8.3
	High volumes of water	3	1.7
	Others(N/A)	45	25
	Total	180	100.0
Water resources	Increased water availability	22	12.2
	Decreased water availability	133	73.9
	Decreased water quality	24	13.3
	Others	1	0.6
	Total	180	100.0
Land resources	Decline in soil fertility	70	38.9
	Soil erosion	22	12.2
	Land degradation	20	11.1
	Loss of vegetable cover	62	34.4
	Loss of indigenous plants	2	1.1
	Others	4	2.2
	Total	180	100.0

Source: *Field data, 2013*

Agriculture in Soroti district is purely rain fed and it is the main source of livelihood for 91% of the respondents (Figure 6). The unseasonal and irregular rainfall patterns have therefore negatively affected crop and livestock farming threatening food security, and wellbeing of the people. The main impacts of climate variability and change in Soroti district have been crop damage and in some instances total crop failure due to extended dry spells and delay in the onset of rains. As noted from the focused group discussions, the extended dry spells in the

2013 March – April – May (MAM) season had a significant negative impact on the on the harvest and the general household food security. It led to serious crop damage and subsequent poor harvest.



Plates 1: Damaged groundnuts due to extended dry spell in 2013 first season

Source: Field data, 2013

In terms of livestock production, the study found out that drought and delay in the onset of rain led to poor grass regeneration and forage deficit, water shortage and heat stress on livestock, and consequently increased the mortality of the livestock. The information gathered from the District Agricultural officer indicated that the animals were more susceptible to diseases such as anthrax, sheep and goat pox, *coccidiosis* and *Salmonellosis*. The IPCC's fourth assessment report highlighted the impact of climate change on the distribution of a number of infectious disease vectors, and the seasonal distribution of some allergenic pollen species. According to this report, diseases that were previously limited to low latitudes have spread to higher latitudes. Insect borne diseases such as *trypanosomosis* and *anaplasmosis* are now found in parts of the world where their vectors have never been found in the past. Climate, in association with land use change, has been associated with global increases in morbidity and mortality from emergent parasitic diseases (IPCC, 2007).

Heavy rainfall was found to have both negative and positive impact on livestock production. The positive impacts include enhanced grass regeneration and increased water availability, while the negative ones include livestock deaths from bloating, over-eating of already weak animals that survived drought as was noted from the focused group discussions.

Natural ecosystem and biodiversities are also affected by the changing climate. Respondents from the focused group discussion sited that they have experienced loss of some native plants and species within the surrounding forests, grass land and wetlands. 41.1% of the respondents

from the household survey also indicated that they are experiencing low fish catches as a result of reduction of fish quantities.

Although there are sufficient water sources as observed from the numerous boreholes and wells within the district, the local people said that they are facing more dry spell periods resulting into the decrease of water in these source. This may affect agriculture, and subsequently food security. The other impact of climate variability and change include decline in soil fertility and soil erosion from heavy rainfall especially in Gweri Sub - county which is flood prone.



Plates 2: Soil erosion due to run off in Gweri Sub – county

Source: Field data, 2013

5.4 VULNERABILITY

5.4.1 Vulnerable groups

The highest proportion of the respondents (39%) felt that the women are most vulnerable, followed by the poor (31%) and the less educated (14%).

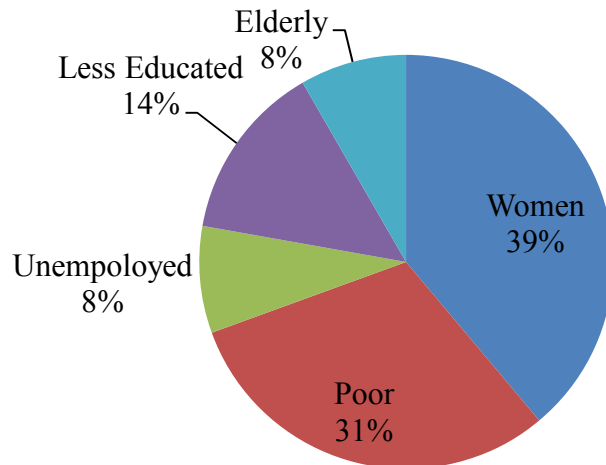


Figure 13: Vulnerable groups

Source: Field data, 2013

The poor

The District Environment Officer (DEO) pointed out that the poor are more vulnerable to climatic shocks because they depend on natural resource such as land as their source of livelihood hence when there is drought or floods, these sources of livelihood are negatively impacted making them more vulnerable. The poor also depend on daily wage labour and have low income and fewer reserves to absorb climatic shocks. Respondents from the focussed group added that poor do not have access to credit and loans due to the general perception that they cannot afford paying it back.

Results from Figure 4 indicate that majority of those working earn below 100 thousand Ugandan shillings per month thus increasing their level of vulnerability to climatic extremes due to their low income levels. Condition of the houses in the study areas shows that most of the houses are traditional houses (mostly made of unbaked bricks and wood). This also displays vulnerability of the whole community during natural disasters especially in Gweri Sub County which is considered flood prone. Cross-referencing the house construction structure, employment status and levels of education shows the poverty level of the district as a whole. A study conducted in Bangladesh by Brouwer *et al.* (2007), shows that households

with lower income and less access to productive resources are more vulnerable in terms of climatic risk exposure. They also show that under the climatic shock, and with presence of income and asset disparity, individual households become more vulnerable at collective or community level since the collective level is least capable to face a common shock like a flood.

Women

Results from the household survey, focused group discussions and the key informant interviews all indicate that women are more vulnerable to climate change and variability compared to men. The vulnerability of women was explained from their lack of access to property, confinement at home caring for children and family members, poor nutritional status and lack of empowerment. According to the district, Environment officer,

“Women’s closeness to family members and confinement at home makes them suffer the most, because men can move to nearby towns to look for alternative source of livelihood”.

Aguilar. L. (2009) argues that women tend to have more limited access to the assets - physical, financial, human, social, and natural capital— that would enhance their capacity to adapt to climate change, such as land, credit, decision making bodies, agricultural inputs, technology, and extension and training services. Thus any climate adaptation strategy should include actions to build up women’s assets and ways to reduce climate-related risks such as improving their access to skills, education, and knowledge and strengthening their ability to prepare for and manage risks.

Less Educated

Education status of the household heads has been explored through the survey (figure 3). The study shows that primary education has been completed by a large proportion of interviewed people, but also a high percentage of the respondents have been presented as illiterate. Higher, secondary and Tertiary education has been achieved by a very small percentage of the respondents. The overall education status of the households heads shows adult literacy level is lower in the community as a whole yet higher education levels increases possibilities of open mindedness and creation of new ideas. In these circumstances adults in this community have less possibility to adapt alternative livelihoods if it becomes necessary due to climate variability and change.

5.4.2 Vulnerability by source of livelihood

Results from figure 6 indicates that majority of the respondents (91%) indicated that farming is their main source of livelihood. Most of the respondents (97.2%) also indicated that they were practicing rain fed agriculture (Table 8). This means that they directly depend on rainfall in their farming practices. Most studies agree that rain fed agriculture is highly vulnerable to climate change and variability (Deressa *et al*, 2000; Eriksen, 2000; FAO, 2008) yet the district's agriculture sector is dominated by small scale farmers, who largely depend on rain for crop production. Any change in climate, mostly manifested as an increase in low rainfall amounts, frequency and severity of extreme weather events such as drought and floods has a potential to significantly reduce agricultural production and household food security.

Hypothesis 2: Vulnerability to climatic extremes varies significantly with the education levels of the household heads

Table 13: Distribution of climate related risks by education level of household head

Climate related risk experienced		Education level of Household head					
		None	Primary	Senior	Higher	Tertiary	Total
Droughts	Count	22	97	25	2	7	153
	% within education level	88.0	85.8	83.3	100.0	87.5	85.9
Floods	Count	17	66	13	1	3	100
	% within education level	68.0	58.4	43.3	50.0	37.5	56.2
Landslides	Count	0	0	0	0	0	0
	% within education level	0.0	0.0	0.0	0.0	0.0	0.0
Hailstorms	Count	1	9	5	0	0	15
	% within education level	4.0	7.9	16.7	0.0	0.0	8.4
Disease & pest epidemics	Count	4	21	5	1	2	33
	% within education level	16.0	18.6	16.7	50.0	25.0	18.5
Lightning strikes	Count	0	0	0	0	0	0
	% within education level	0.0	0.0	0.0	0.0	0.0	0.0
Bush fire	Count	0	0	1	0	0	1
	% within education level	0.0	0.0	3.3	0.0	0.0	0.56
Decreasing water resources	Count	4	5	0	1	0	10
	% within education level	16.0	4.4	0.0	50.0	0.0	5.6
Invasive weeds	Count	0	3	1	0	0	4
	% within education level	0.0	2.7	3.3	0.0	0.0	2.2

Extinction of some indigenous species	Count	0	2	0	0	0	2
	% within education level	0.0	1.8	0.0	0.0	0.0	1.1
Lack of pasture	Count	3	10	5	0	2	20
	% within education level	12.0	8.85	16.7	0.0	25.0	11.2
Poor harvest	Count	15	79	20	1	3	118
	% within education level	60.0	69.9	66.7	50.0	37.5	66.3
Food shortage	Count	21	74	19	2	5	121
	% within education level	84.0	65.5	63.3	100.0	62.5	67.9
Increasing water volumes	Count	1	2	2	0	0	5
	% within education level	4.0	1.77	6.7	0.0	0.0	2.8
Total	Count	88	368	96	8	22	582
	% within education level	352.0	325.7	320.0	400.0	275.0	326.9
<i>Test of hypothesis/significance</i>		<i>Chi-square=206.714 Degrees of freedom=204 p-value=0.396</i>					

A significant relationship could not be established between type of climate related risk experienced and education level of household head ($p > 0.05$). This implies that vulnerability does not vary with education level of householdheads.

5.5 COPING AND ADAPTATION STRATEGIES

The results show the highest proportion (33.3%) of households that had experienced drought applied wage labour as a major coping mechanism to the climatic risk .The biggest fraction of households (23.9%) that had experienced floods also applied grain storage as a major coping mechanism to the climate risk. The largest proportion of households (21.7%) that had experienced poor harvest applied wage labour as a major coping mechanism to the climatic risk The biggest fraction of households (19.4%) that had experienced food shortage also applied grain storage as a major coping mechanism to the climatic risk (Table 12 and 13)

Table 14 : Coping mechanisms applied for the major climatic risks

Climate related risk	Coping Mechanism	Frequency	%
Drought	Sell of household assets	21	11.7
	Reduced socialization for saving	2	1.1
	Wage labour	60	33.3
	Making local drink	10	5.6
	Petty trading	35	19.5
	Grain storage	40	22.2
	Credit from merchants or money lenders	2	1.1
	Buy food on credit	7	3.9
	Consumption of wild fruits/game meat	3	1.7
	Total	180	100.0
Floods	Sell of household assets	20	11.1
	Government assistance	2	1.1
	Wage labour	33	18.3
	Petty trading	34	18.9
	Migration in search of employment	2	1.1
	Grain storage	43	23.9
	Buy food on credit	15	8.3
	Conservation Agriculture	31	17.2
	Total	180	100.0

Table 15: Coping mechanisms during poor harvest and food shortage

	Coping Mechanism	Frequency	%
Poor harvest	Sell of household assets	10	5.6
	Wage labour	39	21.7
	Making local drink	12	6.7
	Petty trading	21	11.7
	Reduction of consumption level	30	16.7
	Grain storage	30	16.7

	Buy food on credit	31	17.2
	Borrowing food	4	2.2
	Others (food aid)	3	1.7
	Total	180	100.0
Food shortage	Sell of household assets	10	5.6
	Wage labour	30	16.7
	Petty trading	23	12.8
	Giving community service (food for work)	5	2.8
	Reduction of consumption level	34	18.9
	Migration in search of employment	13	7.2
	Grain storage	35	19.4
	Borrowing food	24	13.3
	Consumption of wild fruits/game	3	1.7
	Others (food aid)	3	1.7
	Total	180	100.0

Source: Field data, 2013

When faced with the above unpredictable climate related risks, the residents from Soroti District adopt different mechanisms to cope. Much of this response is reactive, in the sense that it is triggered by past or current events such as flood and drought occurrences but it is also anticipatory in the sense that it is based on some assessment of conditions in the future for example rainfall occurrence. Some coping strategies are undertaken before the occurrence of a climatic risk while others are activated as the risks evolves.

It is evident from this study that the most common coping mechanisms employed by the locals to reduce vulnerability to climatic shocks, residents are wage labour (farm or non - farm activities that the locals engage in to earn income) and grain storage (Table 12 and 13). However these coping strategies are not sustainable because employment opportunities are not always available to the locals and in instances when there is poor harvest; the people lack enough grain to store for future use.

5.5.1 Adaptation technologies

Results show that the main adaptation strategies to climate shocks are crop diversification (86.7%), shifting planting dates (95.6%) and diversifying from farming to non-farming

activities (54.5%) It is was also noted that a significantly smaller percentage of households use irrigation (3.3%) (Table 14)

Table 16: Adaptation technologies used to deal with climatic shocks

Adaptation strategies to climatic extremes	YES		NO	
	F	%	F	%
Diversify crops	156	86.7	24	13.3
Shift planting dates	172	95.6	8	4.4
Irrigation	6	3.3	174	96.7
Change from crop to livestock farming	2	1.1	178	98.1
Migrate to urban area	40	22.2	140	77.8
Change quantity of land under cultivation	21	11.7	159	88.3
Implement soil conservation techniques	57	31.7	123	68.3
Diversify from farming to non-farming	98	54.4	82	45.6

Source: Field data, 2013

The results indicate that most households in this study preferred multiple adaptation measures to deal with various climatic risks. For instance most households employed crop diversification, shifting of planting dates and diversifying from farming to non farming activities to deal with climatic extremes.



Plates 3: Respondent making ropes for sale.

Source: Field data, 2013

For the local people, crop diversification to an extent, guarantees good harvests; however, there are years in which farmers report total crop failure therefore policies on adaptation that target such farmers should be worked out consultatively with farmers to ensure that feasible farmer adaptations are promoted and supported. The cultivation of both short and long cycle crop varieties enables the households to take advantage of the different maturing times of crops, to strengthen their resilience to impacts associated with variable unpredictable rainfalls and drier conditions, in order to increase chances of having good harvest during the drier and wetter seasons. In Gweri Sub County for instance the locals have ventured into rice farming in nearby wetlands.



Plates 4: Rice farming as an adaptation measure in Gweri Sub- County

Diversification has been identified as a potential farm-level adaptation to climatic variability. This is consistent with the results of a study that was conducted in Tanzania. Paavola (2004) found out that farmers alter the mix of crops, switch between crops and change planting dates in the light of evidence they obtain of the growing season. Another study carried out by Kasirye (2010) found out that farmers in Uganda use mixed cropping and diversification of crops as a form of insurance against rainfall variability and pests attack. The risk of complete harvest failure due to a climatic event such as drought, intense rainfall or high temperature spells, is reduced by having different crops in the same field or various plots with differing crops since not all crops and fields are affected the same way by such climate events (Kasirye, 2010). However, limitations associated with cultivating crops simultaneously are

low yields as a result of limited time, labour and capital. Although migration of family members is very rare in the district, seasonal migration takes place in search of employment to meet the household expenditure in times of food shortage.

5.6 Major challenges that hinder effective Adaptation

Results in table 15 show that, the key issues that hinder effective adaptation as identified in this study include lack of money (33.3%) poverty (27.2%), lack of information (19.1%) and lack of technology (13.4%).

Table 17: Major constraints that hinder the ability to adapt

Constraints	Frequency	Percent (%)
Lack of money	60	33.3
Lack of Information	35	19.1
poverty	49	27.2
Lack of credit	3	1.9
Lack of technology (agricultural inputs)	24	13.4
Lack of Extension service	7	3.9
lack of market access or poor transport link	2	1.2
Total	180	100%

Source: Field data, 2013

Lack of financial resources and poverty are the main constraints that hinder adaptation in Soroti District. The study found out that despite numerous adaptation options that locals were aware of and willing to apply, lack of sufficient financial resource to invest in and purchase the necessary inputs and other associated equipment (eg. seeds, feeds) were significant constraints to adaptation.

It is also obvious that if household members need to change their present occupation due to any climate change related risks, they will probably face great challenge due to lack of capital, and poverty which limits their ability to diversify from farm to non – farm practices. Paavola, (2004) indicates that poor households often face difficulties and constraints in agricultural production related to varying climate, as compared to other households.

The other major constraints included lack of information and lack of technology .Access to extension services and technology can significantly increase the probability of taking up adaptation options. In the study area however, the respondents claim they have little access to

extension services and sometimes the information and services obtained from the concerned institutions are sometimes un-useful or inappropriate.

CHAPTER 6: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6 Introduction

The section is divided into three sub-sections. The first sub-section provides the summary of results. The second sub-section provides the conclusion from the findings while the last sub section outlines the recommendations for policy action and areas for further research.

6.1 Summary of results

From the analysis of the meteorological data it's clear that there has been significant changes in temperatures and precipitation in recent decades. The average annual rainfall over the past 50 years shows a decreasing trend in rainfall amounts in the district while the temperature analysis suggests a gradual increase in the aggregate mean annual temperatures from 1971 to 2007. The respondents' perceptions are consistent with the actual climatic data. The locals argue that the rainfall has become highly variable with frequent dry spells between seasons. . 72.3% of the respondents reported that the rainfall on-set was late while the 66.1% claimed that rainfall amounts were light. 64.4% also mentioned that rainfall cessation was early (64.4%).

The frequent delay of rainfall onset, erratic precipitation, extended dry spells, and heavy rainfall is a grave concern for all communities in the district due to their impacts on agriculture and natural resources. The impacts on agriculture include crop failure and crop damage yet agriculture is the main source of livelihood in the entire district. Drought and delay in the onset of rain was found to have effect on livestock production due to poor grass regeneration and forage deficit, water shortage and heat stress on livestock leading to increased livestock mortality. Natural ecosystem and biodiversity are also affected by the changing climate. Respondents cited loss of some native plants and species within the surrounding forests, grass lands and wetlands. Soil erosion, decreased water availability, low fish catches are other impacts experienced by the locals.

Though, the entire district is vulnerable to the impact of climate change and variability, vulnerability is heightened on the poor, women, large family size, and the less educated. The main constraints that increase vulnerability and hinder effective adaptation as identified in this study include, lack of financial resources, poverty, lack of information and lack of technology.

It is evident from the study that the locals in Soroti district prefer multiple adaptation strategies to counter the effects of climate variability and change. The current local adaptation

strategies include crop, diversification, shifting planting dates, off farm jobs and diversifying from farm to non – farm activities. However majority of the respondents employ crop diversification as the main adaptation strategy. For the locals' crop diversification does, to an extent, guarantees good harvests although there are years in which farmers report total crop losses. The cultivation of both short and long cycle crop varieties enables the households to take advantage of the different maturing times of crops, to strengthen their resilience to impacts associated with variable unpredictable rainfalls and drier conditions, in order to increase chances of having good harvest during the drier and wetter seasons.

6.2 Conclusion

Climate change and variability is already affecting the planet. Rural communities are experiencing changing pattern of rainfall, increase in temperatures, changing time of cultivation of crops, changing behaviour of animal among others. The production and productivity of the food grain as well as cash crops has been decreasing every year.

Climate change and variability in eastern Uganda has a strong influence on the local's livelihood sources. In Soroti district, the main source of income for residents is agriculture which is highly sensitive to climate variability. The households depend on rain-fed agriculture for their livelihoods, with cassava and potatoe production being common among the households. Improvement on the food security status of the household therefore depends on a successful rainfall season. However, with current and future climate change and variability, this will increase vulnerability to food insecurity.

The district also has large numbers of poor households characterized by low annual income, low education status and lack of resources to improve the welfare of the households. The poor are therefore more vulnerable to climate change, since they have fewer options to mitigate against the impacts of climate change and variability. As a result of this the locals employ various strategies to deal with climatic shocks. Popular adaptation methods among households who perceived changes in climate are planting different crops, crop diversification and diversifying from farming to non-farming activities. The adaptation strategies used by households are less numerous and practiced only sporadically but are nonetheless useful tools to mitigate vulnerability. However with the increasing impacts of climate change and variability, some of these strategies may not be viable in the long run.

Future climate change is likely to threaten agricultural systems through the increasing unpredictability of precipitation and a severe increase in mean temperature thereby reducing

the available range of coping and adaptation strategies that the households have. Adaptation strategies therefore have to be practiced at a broader scale and be fully understood if they are to successfully make households less vulnerable to future changes in climate.

6.3 Recommendations

6.3.1 Recommendations for policy makers

From this study, it is evident that households do perceive their microclimate variations and are able to cope and adapt. For instance, the locals adapt to climate variability through a range of adaptations measures such as crop diversification, off farm – jobs and migration in search of employment. The views suggest that people’s perceptions provide insights to what they really need and prefer in adapting to climatic variability. There is therefore a need for the integration of local knowledge in government climate policies to improve adaptation and enhance local adaptation strategies. The existing knowledge points out what needs to be improved to enhance adaptive capacity and demands that the locals should be involved in adaptation interventions and search for solutions rather than prescribing solutions, which they may not view as feasible.

To improve resilience and enhance adaptation to climate change and variability, there is a need for the government to alleviate poverty and unemployment within the district by creating employment opportunities for the locals. Income generation through different indigenous and modern economic activities and flow of money through local level co-operatives within the community is very beneficial not only to reduce the risk but also to enhance the economic status of the local people

It is evident from the study that the education level in Soroti district is very low. The government and other stakeholders should take initiative to encourage and support the locals to attain higher education. Better educated people are better able to respond and adapt to climate change.

There is a need to increase public awareness on climate change issues. The people’s ability to effectively respond to challenges of climate variability and change is determined by the quality of the information available to them and how easily they can access it. The role of awareness creation is that of everybody, but the government, Non- governmental Organizations and other relevant stakeholders should take the lead.

Women tend to have more limited access to the assets - physical, financial, human, social, and natural capital - that would enhance their capacity to adapt to climate change, such as

land, credit, decision making bodies, agricultural inputs, technology, and extension and training services. Thus any climate adaptation strategy by government and other stakeholders should include actions to build up women's assets. Interventions should pay special attention to the need to enhance women's capacity to manage risks with a view to reducing their vulnerability and increasing their opportunities for development.

The locals should engage themselves in the reduction of Climate variability impacts through a forestation and biodiversity conservation.

The government should ensure mainstreaming of adaptation to climate change into policies and programmes in different sectors (focusing on disaster management, water, environment agriculture, health, and industry). Government inclusion of climate variability and change issues in curriculum at secondary and tertiary educational institution can help in increasing awareness

6.3.2 Recommendations to future researchers

A study needs to be conducted on future climatic scenarios and their impacts on different livelihood sources within the district. There is also a need to conduct a study on the cultivation of cash crops to enhance food Security in the district. This is because most residents focus on planting food crops only. Government, Nongovernmental organizations and other sectors should promote research on flood and drought tolerant varieties of crops to facilitate adaptation in future.

As an adaptation measure to the varying climate, the locals in Gweri Sub County have began practising rice farming in the nearby wetlands within the sub county. However a study should be conducted to determine the impact of rice farming on wetlands

Most respondents reported that there is an increase in livestock diseases within the district as a result of climate variability and change. A Study should however be conducted to ascertain the relationship between and livestock diseases.

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APPENDICES

Appendix 1

Household questionnaire

HOUSEHOLD VULNERABILITY AND ADAPTATION TO CLIMATE CHANGE AND VARIABILITY IN SOROTI DISTRICT, EASTERN UGANDA

N.B This information is confidential and is between the interviewer and the respondent.

DATE:

NAME OF INTEVIEWER.....

VILLAGE NAME AND CODE.....

RESPONDENT CONTACT INFORMATION..... (OPTIONAL)

A. COMPOSITION AND CHARACTERISTICS OF HOUSEHOLD

Please fill in the household characteristics information with the interviewee.

1	2	3	4	5
Size of the household	Gender of Household head	Age of household head(years)	What is marital status of the household head?	Education level?
1 – 5.....1	Male.....1	15-25.....1	Single.....1	Preschool...1
6 – 10.....2	Female...2	26-35.....2	Married.....2	Primary.....2
11- 15.....3		36-45.....3	Widowed.....3	Senior.....3
Above 15...4		46-55.....4	Separated.....4	Higher.....4
		>56.....5		None.....5

6. Main house - type of walls	<ol style="list-style-type: none"> 1. Mud & Wattle 2. Wood panel 3. Bricks 4. Stones
7. Main House - type of roof	<ol style="list-style-type: none"> 1. Grass thatched 2. Iron sheet 3. Straw/bamboo roofed 4. Tiled
8. Household means of transport	<ol style="list-style-type: none"> 1. Own bicycle 2. Own motor cycle 3. Hire boda boda 4. Taxis
9. Current employment status	<ol style="list-style-type: none"> 1. Full-time work 2. Part-time work 3. Self employed 4. Homemaker (at home caring for
10. If working, how much money do you earn per month (approximately)? If not working go to Q 11	

11. Main source of livelihood?	<ol style="list-style-type: none"> 1. Farming 2. Employment 3. Business 4. Other specify....
12. What kind of farming system do you practice? (IF NOT GO TO Q19)	<ol style="list-style-type: none"> 1. Crop farming only 2. Livestock rearing/herding only 3. Mixed farming (Crop and Livestock production)
13. What type of agriculture do you practice	<ol style="list-style-type: none"> 1. Rain-fed 2. Irrigated. 3. Mixed

14. Why do you do farming?	<ol style="list-style-type: none"> 1. Subsistence 2. Commercial 3. Both
15. Source of farm labour?	<ol style="list-style-type: none"> 1. Family labour 2. Shared labour 3. Animal Traction 4. Tractor
16. In which category do you classify your soil on basis of its fertility?	<ol style="list-style-type: none"> 1. Infertile 2. Less fertile 3. Fertile 4. Highly fertile
17. Has your farm been degraded (land cutting, decreasing productivity) by climate related disasters and extremes during past 10 years?	<ol style="list-style-type: none"> 1. Yes 2. No

18. Land productivity

Type of crop	Production last year (Kgs)	Production before (5years)

B. ASSETS

19. Land size (Ownership)	<ol style="list-style-type: none"> 1. 1 – 2 acres 2. 3- 4 acres 3. 5 and Above
20. Livestock ownership	<ol style="list-style-type: none"> 1. 1- 5 2. 6 – 10 3. Above 10

C. ACCESS TO FACILITIES AND SERVICES

21. Television	1. Yes 2. No
22. Radio	1. Yes 2. No
23. Electricity	1. Yes 2. No
24. Access to credit	1. Yes 2. No

25. Time taken to reach nearest vehicle station?	1. Less than one hour 2. One hour 3. More than one hour
26. Time taken to reach nearest health centre from your house? (One way)	1. Less than one hour 2. One hour 3. More than one hour
27. Time taken to reach the nearest market where you <i>sell</i> your harvest or livestock products (one-way)?	1. Less than one hour 2. One hour 3. More than one hour

D. NATURAL CAPITAL

28. Are there natural resources (forests, bush lands, wetlands) within the community?	1. Yes 2. No
29. What product do you collect from these resources	1. Herbs 2. Firewood 3. Wild fruits
30. For what purposes do you collect these products?	1. Subsistence 2. Commercial
31. What other activities do you conduct in forest/bush lands/wetlands for your livelihoods?	1. Livestock grazing 2. Tourism based income 3. None
32. Is there any plant or wildlife that has disappeared from the forest/bush land/wetland in the last 20 years?	1. Yes 2. No 3. DK

33. If yes what is the cause of disappearance? (If no go to Q33).	1. Lack of water in the forest 2. Lack of food 3. Change in climate
34. Do you have any water sources within the community?	1. Yes 2. No
35. If yes do you feel the changes in quality and quantity of water	1. Yes 2. No
36. If yes what may be the cause of the change? (If no go to Q37)	1. Increased temperatures 2. Drought
37. Where do you collect water for domestic use from?	1. Tap 2. River/ streams
38. Is this water available every day?	1. Yes 2.No
39. How long does it take to get to your water source?	1. Less than one hour 2. One hour

E. ACCESS TO INFORMATION ON CLIMATE CHANGE

40. . Have you heard of the word “climate change” before	1. Yes 2. No
41. Do you receive information on climate change	1. Yes 2.No
42. Source of information on climate change?	1. Radio 2. Local Newspaper 3. Television 4. N/A 5. Other specify.....

F. KNOWLEDGE OF CLIMATE CHANGE AND VARIABILITY

43. Over the last 5 – 30 years have you noticed any changes in weather	1. Yes 2. No
If yes What changes have you observed?	
43a. Rainfall on- set	1. Early 2. Normal
43b. Rainfall amounts	1. Light 2. Normal
43c. Rainfall seasonal distribution	1. Normal 2. Heavier in first season
43d. Cessation (end of rainy season)	1. Early 2. Normal
43e. Temperature	1. Lower 2. Moderate

44. List the major 4 climate related risks you have experienced in the last 5 – 30 years	<ol style="list-style-type: none"> 1. Droughts 2. Floods 3. Landslides 4. Hailstorms 5. Disease and Pest epidemics 6. Lightning Strikes 7. Bush fire 8. Decreasing water resources 9. Invasive weeds 10. Extinction of some indigenous plant and animal species. 11. Lack of pasture 12. Poor harvest 13. Increasing water volumes 14. Others.....
45. Who do you consider to be most vulnerable to these impacts	<ol style="list-style-type: none"> 1. Women 2. Less educated 3. The poor

	4. Elderly 5. Unemployed
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46. What did you do to cope with the climatic risks?	
Climate related risk	Coping mechanism

Codes for Q 46

1. Inter household transfers and loans, 2. Sell of household assets, 3. Insurance 4. Begging, 5. Government assistance, 6. Reduced socialization for saving 7. Wage labour, 8. Making local drink, 9. Selling forest products, 10. Handicraft work, 11. Petty trading, 12. Renting tools/animals, 13. Giving community service (food for Work), 14. Reduction of consumption level 15. Migration in search of employment 16. Grain storage 17. Mortgaging of land 18. Food appeal/aid 19. Credit from merchants or money lenders 20. Other (specify)

47. What has been the Main Impacts of Climate change on livelihood sources?	
Crop farming	1. Crop failure 2. Crop damage 3. Pest Infestation
Livestock farming	1. Lack of feeds 2. Water shortage 3. Low milk production
Fishing	1. Low fish catches 2. High fish catches 3. Low fish weight
Water resources	1. Increased water availability. 2. Decreased water availability 3. Decreased water quality

Land resources	<ol style="list-style-type: none"> 1. Decline in soil fertility 2. Soil erosion 3. Land degradation
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G. ADAPTATION TECHNOLOGIES

Adaptation strategies to climatic extremes	YES	NO
	F	F
Diversify crops		
Shift planting dates		
Irrigation		
Change from crop to livestock farming		
Migrate to urban area		
Change quantity of land under cultivation		
Implement soil conservation techniques		
Diversify from farming to non-farming activities		

48 a. Do you think the adaptive mechanism(s) you employed is the best and viable one in current and future climate change and variability?	<ol style="list-style-type: none"> 1. Yes 2. No
48 b. If your answer to question 48a is No, what other adaptation mechanism(s) do you think is appropriate? (Use codes for Q47)	
48. Which type of climatic shock is your main concern?	<ol style="list-style-type: none"> 1. High rainfall intensity 2. Floods 3. Landslides 4. Drought

	<ul style="list-style-type: none"> 5. Change in temperatures 6. Other specify.....
<p>49. What are the major constraints you have that hinders your ability to adapt?</p>	<ul style="list-style-type: none"> 1. Lack of money 2. Lack of Information 3. poverty 4. Lack of credit 5. Lack of technology (agricultural inputs) 6. Lack of Extension service 7. lack of market access or poor transport link 8. Other.....

Thank you

Appendix 2

Key informant Questionnaire

District Agricultural Officer, District environment officer,

Name Position/profession

1. Has there been any form of climate change and variability in your district in the last 5 – 30 years? If your answer is yes, please can you explain?
2. If the answer to Q2 is yes, please explain the extent of climate change and variability?
3. What is the impact of climate change and variability on the livelihood of the people there? (i.e on Crop farming, Livestock farming, land resources. Forest resources, water resources, food security and nutrition)
4. Which areas are prone to climatic shocks e.g. floods, drought, and other extreme weather events. (identify areas (hotspots) and groups of people more at risk to climate change and variability in relation to food and nutrition security, land & water resources degradation food and nutrition insecurity; land, water resources and ecosystem degradation)
5. How has climate variability and change affected food security and nutrition in the district?
6. Who are the most vulnerable groups to the impacts? Why?
7. What are the local coping mechanisms used to reduce the impacts?
8. What is the institutions effort to reduce future impacts?
9. What are the main challenges and how do you think they can be improved?
10. Are there facilitations and supports from local government to strength individual farmers' adaptive capacity to climatic changes?
11. Are there Capacity building opportunities available for the district leaders relating to climate change?
12. Are there polices that improve farmers' productivity and adaptive capacity, including polices on new technology extension, farming infrastructure development, transparent market and price scheme, etc.

Thank you

Appendix 3

Guiding questions for Focus Group Discussion (FGD)

Address (location) of the village: -----

Focus group size: -----

Focus group composition: # male----- #female---- # youth-----

1. Do you feel the pattern of weather is generally changing?
2. Over the last 5 – 30 years have you noticed any changes in weather patterns?
3. What do you think is the cause of the change?
4. Have you heard of “climate change”? From which sources?
5. What are your traditional or local indicators to realize that there are these changes?
6. What has been the Main Impacts of Climate change **on crop farming, Livestock farming, Land resources, forest ecosystem and water resources within the community**
7. How has climate change and variability affected food security within the community?
8. Is this area drought and/or flood prone? If yes, explain the frequency (mention the years of Climatic extremes)?
9. What can you say about intensity/strength of climatic extremes (flood and drought) compared to scenarios 10 – 20 years ago?
10. What are the local coping mechanisms used to reduce the impacts?
11. What are the major challenges to cope?
12. What customary self-help arrangements are there to support each other in your villages during the times of climatic extremes?
13. Do you have easy access to agricultural inputs such as seed?
14. Do you have access to credit?
15. Do you receive early warning information on short term variations and/or long term climate change from any sources?

Appendix 4: Field work photos

