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# CLIMATE CHANGE AND ADAPTATION OPTIONS IN KARAMOJA

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## ACRONYMS AND ABBREVIATIONS

ACTED	Agency for Technical Cooperation and Development
CA	Conservation Agriculture
CBPP	<i>Contagious Bovine Pleuropneumonia</i>
CMDRR	Community Managed Disaster Risk Reduction
DCA	DanChurchAid
DDP	District Development Plan
DEAP	District Environment Action Plan
DSIP	Development Strategy and Investment Plan
FAO	Food and Agriculture Organization
CIGI	Centre for International Governance
GOU	Government of Uganda
HDI	Human Development Index
HPI	Human Poverty Index
FPRI	International Food and Policy Research Institute
IPCC	Intergovernmental Panel on Climate Change
IRC	International Rescue Committee
KIDDP	Karamoja Integrated Disarmament and Development Program
MWLE	Ministry of Water, Land & Environment
NAADS	National Agricultural Advisory Services
NDP	National Development Plan
NEMA	National Environment Management Authority
NGO	Non Government Organization
NR	Natural Resources
PRDP	Poverty Reduction Development Plan
PPR	<i>Peste de Petitis Ruminants</i>
SEAP	Sub-county Environment Action Plans
SLM	Sustainable Land Management
SSA	Sub-Saharan Africa
TA	TerrAfrica
UBOS	Uganda Bureau of Statistics
UNDP	United Nations Development Program
UN-JFCC	United Nations Joint Action Framework on Climate Change
WFP	World Food Program
ZOA	Refuge Care

## GLOSSARY OF TERMS

- I. **Adaptation to climate change:** adjustments or interventions which take place in order to manage the losses or take advantage of the opportunities presented by a changing climate.
- II. **Agro-ecological Zone:** is defined on the basis of average annual length of growing period for crops, which depends among other things on rainfall and temperature. The lengths are: humid > 270 days; moist sub humid 180 – 269 days; dry sub humid 120 – 179 days; semi arid 60 – 119 days and arid 0 – 59 days.
- III. **Borehole:** is a shallow (<40 m) or deep (<80 m) and in most cases machine drilled well.
- IV. **Climate:** situation of a climate system, including the statistical description, taking into account averages and variations in temperature, rainfall, winds and other relevant meteorological factors in a given period.
- V. **Climate change:** the change in climatic variables over time or a statistically significant variation in the climate, both in terms of average states and variations, on a space and time scale, directly or indirectly attributed to human activities that alter the composition of the Earth's atmosphere, plus the natural variation observed over comparable periods of time, which persist for time scale of decades or longer.
- VI. **Climate variability:** the variations in the mean state and other statistics (standard deviation, occurrence of extreme events) of climate on all time scales beyond that of individual weather events. Variability may be due to natural processes within the climate system or to variations in natural or anthropogenic external forcing.
- VII. **Food security:** the situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.
- VIII. **Ferro cement tank:** The structure/ frame of the tank is usually made from wire mesh and a mortar of sand and cement is used to make the wall
- IX. **Global warming:** intensifying greenhouse effect resulting from anthropogenic actions where the consequence is an increase in the concentration of greenhouse gases, aerosols or their precursors in the atmosphere, which absorb part of the infrared radiation emitted by the Earth's surface, thus increasing the average temperature on the planet and causing adverse climatic phenomena.
- X. **Kraals:** mobile or semi-mobile livestock camps. They are inhabited by a shifting population of adolescent males and females, women, men, and children.
- XI. **Manyatta:** semi permanent homestead inhabited by men, women, children and the elderly. They are usually near areas used for cultivation.

- XII. **Mitigation:** action or activities that lead to the reduction of a cause(s) of a given impact or reducing the undesirable risk to the minimum level possible.
- XIII. **Negative effects of climatic change:** changes in the physical environment or the biota, resulting from climate changes that have a significant harmful effect on the composition, resilience of socioeconomic systems or on human health and wellbeing.
- XIV. **Pan:** small locally constructed or natural depression for short term storage of water normally for watering animals
- XV. **Resilience:** the ability of a system to adapt to climate change, whether by taking advantage of the opportunities or by dealing with their consequences: the analysis of adaptation identifies and evaluates the different options, benefits and costs of the measures.
- XVI. **Sustainable development:** development which meets the needs of the present without compromising the ability of future generations to meet their own needs.
- XVII. **Transhumance:** is the seasonal movement of people with their livestock over relatively short distances in search of pastures and water
- XVIII. **Vulnerability:** the potential to be adversely affected by an event or change or the degree of susceptibility or inability to protect oneself from the negative effects of climate change; a function of the type, magnitude and frequency of the climate events to which a system is exposed, in addition to its sensitivity to and capacity for adaptation.

# EXECUTIVE SUMMARY

## Introduction

Agriculture is the backbone of the Uganda's economy and the livelihood of many people. However, most of the agriculture in Uganda depends on rainfall and therefore inherently sensitive to climate conditions. This makes agriculture one of the most vulnerable sectors to the risks and impacts of climate change and variability. It is projected that crop yields from rain-fed agriculture in some countries in Africa could be reduced by up to 50% by 2020 as a result of climate change.

Natural resources constitute the primary source of livelihood for the majority of Ugandans and the economy of Uganda depends on exploiting its natural resources. Management of these natural resources is therefore important and critical to Uganda's long-term development. Climate is a key determinant of the status of Uganda's natural resources, such as agriculture, forestry, water resources, wildlife, etc. However, climate change, which has started manifesting itself through intense and frequent extreme weather events, is posing a serious threat to the country's natural resources, and social and economic development.

The impacts of climate change create challenges and impose severe losses and hardships on the poorest communities as their livelihoods are likely to be more sensitive to adverse impacts of climate change. The most dominant and widespread disaster due to climate change is drought, whose frequency is observed to be on the increase. Drought has severely affected the agricultural sector leading to impacts such as famine, malnutrition, low production and productivity of crops and animals, etc.

Although all the agro-ecological zones of Uganda are grappling with the effects of climate change and variability, the Karamoja sub region is most affected. This is attributable to the fact that it is the least socially and economically developed in Uganda, even among the generally poorer parts of northern Uganda as a whole. It is characterized by a combination of acute poverty, vulnerability to drought, poor infrastructure and basic services delivery, limited marketing opportunities, natural resource degradation, social and cultural marginalization, long-standing dependency on external aid and most importantly chronic insecurity.

## Study Objectives

The main objective of this study was to identify and document climate change adaptation options and recommend ways they can be mainstreamed both in the emergency and regular development programs/ operations for the Karamoja sub region.

More specifically the study:

- analyzed existing information on climate change scenarios and their impact on the livelihood strategies of the people in the sub region
- conducted field assessments to confirm impacts of climate change on local communities and also assessed on-going adaptation measures/ technologies being used.

- identified and compiled climate change adaptation measures (policy and technical) and recommended ways by which they can be mainstreamed both in the emergency and regular development program sector strategies and operations in Uganda.
- analyzed outreach methodologies used by different players in the sub region and made recommendation on the best outreach strategy/ plan taking into account the socioeconomic realities in the sub region.

## **Methodology**

The study focus area was the Karamoja sub region focusing on its three key livelihood zones (agro-ecological zones): pastoral, agro pastoral, and wet (agricultural) zone. The Concept Note was prepared basing on existing general literature. Field assessments were done by visiting all the districts in the sub region to assess the impact of climate change on the local communities and the adaptation options at their disposal. Information of endowment profiles including physical, social, economic, land use and indigenous knowledge on climate change and variability adaptation/mitigation were obtained through consultative discussions with various stakeholders such as: district local authorities, officials of relevant NGOs, key community leaders, and grassroots communities using focus group discussions.

The rainfall data used in this study consisted of daily rainfall records for the period 1961 – 1985 from the Kotido Station, representing one of the 10 agricultural production zones and 14 rainfall zones of Uganda. The bulk of the daily data was obtained from the Uganda Meteorological Department with some data also directly obtained from the recording station (Kotido).

## **Findings**

Adverse impacts of climate change in Uganda and the study area in particular, include drought, famine, flash floods and flooding, prolonged dry spells and dust storms, among several others. Climate change impacts undermine health and well-being, the economy and overall development of the country. Food insecurity is a major challenge and climate change impacts are making food insecurity worse.

The uni-modal rainfall regime in the Karamoja sub region commences from April to November with peak rainfall during April, May, July and August with laxity of rains during the month of June. Significant increasing trend has been observed for the month of June while decreasing trends dominate the months of September, October and December. Although the observed increase in June monthly rainfall is beneficial as it is in the middle of the season, the observed decrease in rainfall at the end of the season is detrimental as it shortens the length of the potential crop growing period of the region posing challenges to pasture and crop growing.

Adaptation measures are important to help communities to better face the adverse impacts and associated effects of climate change. In this study adaptation measures have been placed in two main categories: (a) physical adaptation measures and (b) institutional adaptation measures. Physical adaptation measures focus on tactic decisions made in response to seasonal variations in climatic variables e.g. early maturing and drought-tolerant plant varieties and animal breeds and crop diversification in the agricultural sector; construction of dams to harvest runoff water in the

water resources management and protection sector; safe water supply and sanitation and kitchen gardening in the health sector; and tree planting in the ecosystem and environmental protection sector. Institutional adaptation measures focus on strategic national decisions and policies on local to regional scales taking into account long term changes in climatic conditions over a long time e.g. increased funding to promote adaptation to climate change, early warning systems, collaborative natural resources management, surveillance systems for existing and new disease risks, etc.

## Main recommendations

### *Climate change adaptation options*

The identified and recommended physical adaptation measures are summarized in the table below. They are grouped in three categories: agricultural production and development, water source management and protection, and ecosystem and environmental protection.

**Table 1: Adaptation/ mitigation needs and the available technologies in Uganda and the region**

Adaptation/ mitigation need	Available technologies (varieties/ types/ practice)
<b>Agriculture Production and Development</b>	
Early maturing and drought tolerant crop varieties and livestock breeds	<p><b>Sorghum:</b> improved varieties – Sekedo; Local varieties – <i>Tinyitinyi</i>; <i>Akirikir</i>; <i>Naterekune</i>; <i>Tinyang</i>; <i>Ekabir</i>, <i>Loyokou</i></p> <p><b>Legumes:</b> Green grams; cow peas; K131(bean); Tepari beans; pigeon peas</p> <p><b>Livestock:</b> Zebu cattle; goats; sheep; camels; donkeys; turkeys; chickens; ducks</p>
Mixed crop-livestock farming systems	Cows and sorghum, cassava, millet, cowpeas, beans, Katumani, green gram, pearl millet, bulrush millet
Mixed cropping/ intercropping	<b>Cereals/ legumes:</b> Maize, K131, Tepari beans, cow peas
Crop diversification	<b>Cereals:</b> Maize; upland rice
Shifting/ adjusting planting and harvesting dates	Early/ dry planting, relay cropping
Soil and water conservation – general	<p>Live/ grass contour bunds/ ridges; stone lines; contour cropping; diversion channels; trenches [reducing the speed of runoff over the land can encourage moisture storage and permit better pasture and crop growth during the dry periods between rainfall events]</p> <p><b>Terraces:</b> Bench terraces; <i>Fanya juu</i> terraces – catchment approach</p>
Conservation agriculture	Minimum soil disturbance/ tillage; judicious crop rotations; cover crops
Agro forestry	Multipurpose trees, tree nurseries, transplanting, grafting
Improving soil moisture	Mulching; manure addition; minimum soil disturbance
Small scale irrigation	Ponds, valley tanks and dams

<b>Adaptation/ mitigation need</b>	<b>Available technologies (varieties/ types/ practice)</b>
	Vegetable production through backyard irrigation
Sustainable utilization of swamps	Paddy rice, crafts-making, utilization of medicinal plants, etc
Integrated nutrient management (INM)	Inorganic & organic fertilizers; BNF; agro-forestry
Animal health	Hay making, pasture management , migratory routes
Post harvest handling	Maize & groundnut shellers; cassava & potatoes chippers; drying pads; treatment with ash/ diatomaceous earth; silos; granaries
<b>Water Resources Management and Protection</b>	
Water harvesting & sustainable water management	Ferro cement tanks; sand dams; water ponds/ pans; sub surface water dams; gravitational water flow systems; water harvesting systems, training of water user committees
Improving existing water sources	Desilting
<b>Ecosystem and Environmental Protection</b>	
Increase forest cover	<b>Afforestation &amp; Reforestation:</b> woodlots / tree planting
Reduce pressure on forests/ deforestation	Energy saving stoves; efficient kilns for charcoal production
Alternative livelihoods	<b>Production and marketing of SLM friendly products:</b> Aloe Vera; Gum Arabic; Shea nut butter; apiary <b>High value crops:</b> fruit trees and vegetables (wide range)
Sustainable use of under-utilized and non-traditional food stuffs	Wild yams (e.g. <i>omwodu</i> ) and fruits (e.g. coconut – <i>tugo</i> )
<b>Health Sector</b>	
Clean drinking water and sanitation	Water boiling & hand washing
Kitchen gardening	Vegetables (wide range: <i>Edowol, Lobolia</i> ) – nutritional
Indigenous knowledge	Herbs for treatment of diseases (wide range) – human and livestock

### **Outreach strategy**

The following is a summary of the main recommendations for outreach:

**1. Awareness creation/ capacity building** – the people of Karamoja need to be made aware of climate change, its drivers and impacts, and the adaptation and mitigation options available locally and in the region. Pupils and students in institutions of learning ought to be involved in adaptation and mitigation strategies e.g. tree planting campaigns

**2. Reach out to the communities through established social structures:** The communities in Karamoja still have well established social structures in spite of changes caused by the prevailing socioeconomic and security situation. To successfully get to the communities, one needs the services of key community leaders. This not only ensures project implementation but also sustainability.

**3. Implement activities through community groups as opposed to individuals:** due to insecurity many communities are organized in Manyattas and activities are undertaken through community groups; this makes mobilization quite easy. That notwithstanding, group members still need to be taught group dynamics, business skills, technological issues, etc. they also need internal and external exposure. **Farmer/ Pastoralist Field Schools should be strengthened for this purpose.**

**4. Participatory approach:** There is need to involve the communities/ groups right at the time of project planning/ inception to create a sense of ownership/ belonging. Where communities/ groups are not involved they tend to look at the intervention as a government or NGO project and none of their business.

**5. Action planning:** it is paramount that community groups develop action plans and these should be developed in a participatory manner giving opportunity to members to suggest the interventions/ technologies to be implemented. There is also a need to consider indigenous knowledge. Rural communities in Uganda have several options at their disposal for coping with climate change impacts. These coping mechanisms should be considered when planning interventions because communities have used these strategies since time immemorial to avoid natural catastrophes weather related or not.

**6. Communication channels** The best information dissemination approach is straight talk i.e. direct interaction with the communities. Reportedly, gatherings especially in church are the best forums for information dissemination. Other good communication methods are:

- Radio; this works well with well packaged information. However, the few radios in the sub region have small coverage. The best time for radio programs is during primetime (news hour) – 7:00am, lunchtime (1:00PM) and 8:00pm
- Cell phones; communication using cell phones is limited as some households do not have sets.
- Posters; this has a limitation in that many people in the sub region are illiterate therefore unable to read and write. However, well illustrated poster pictures have been found useful
- Documentaries

## 1.0 INTRODUCTION

### 1.1 Land degradation

Agriculture is the backbone of the Uganda's economy and the livelihood of many people. However, most of the agriculture in Uganda depends on rainfall and therefore inherently sensitive to climate conditions. This makes agriculture one of the most vulnerable sectors to the risks and impacts of climate change and variability<sup>2</sup>. The IPCC (2007) projects that crop yields from rain-fed agriculture in some countries in Africa could be reduced by up to 50 per cent by 2020 as a result of climate change.

Natural resources constitute the primary source of livelihood for the majority of Ugandans and the economy of Uganda depends on exploiting its natural resources. Management of these natural resources is therefore important and critical to Uganda's long-term development (GOU, 2007). Climate is a key determinant of the status of Uganda's natural resources, such as agriculture, forestry, water resources, wildlife, etc. However, climate change, which has started manifesting itself through intense and frequent extreme weather events such as droughts, floods, landslides, and heat waves, is posing a serious threat to the country's natural resources, and social and economic development (GOU, 2007).

Severe land degradation – caused mainly by conversion of forests, woodlands and bush lands to agriculture; overgrazing of rangelands; unsustainable agricultural practices on croplands; and excessive exploitation of natural resources – is reducing primary productivity on as much as 20% of the land in SSA, with the most severe impacts in drylands and forest margins. Climate variability and change can contribute to land degradation by exposing unprotected soil to more extreme conditions and straining the capacity of existing land management practices to maintain resource quality, contributing to de-vegetation, soil erosion, depletion of organic matter and other forms of degradation. These changes can cause land management practices that were sustainable under other climate conditions to become unsustainable, and induce more rapid conversion of forest or rangeland to unsustainable agricultural uses. At the same time, land degradation increases the vulnerability of agricultural production and rural people to extreme weather events and climate change, as the fertility and buffering capacities of the land and livelihood assets are depleted.

### 1.2 Uganda's vulnerability to climate change and variability

According to the United Nations Joint Action Framework on Climate Change in Uganda, climate change threatens to reverse the hard-won development gains and jeopardize the country's economic development and poverty eradication goals. A recent International Climate Risk Report labels Uganda as one of the most unprepared and most vulnerable countries in the world (CIGI,

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<sup>2</sup>**Climate change** refers to any permanent change in climate over time (change in mean, frequency and magnitude) **Climate variability** on the other hand refers to deviations in the mean state and other statistics (standard deviation, occurrence of extreme events) of climate on all time scales beyond that of individual weather events.

2007). Yet among the most vulnerable countries, Uganda has the least adaptive capacity, making adaptation the most immediate priority for the country.

Poverty, low diversity of income and livelihoods, HIV/AIDS, insecurity and weak institutions are key factors in heightening Uganda's vulnerability to climate change, lowering its resilience and adaptive capacity. Resilience, the ability to cope and recover is low within Uganda. Therefore in planning interventions around climate change it is vital to understand and consider these underlying issues and their often unequal distribution as well as direct sectoral impacts.

Vulnerability, the potential to be adversely affected by an event or change is a key concept for appraising effective interventions and responses to climate change. On the basis of macro level indicators, Uganda can be considered to be highly vulnerable given its dependence on primary production and natural resource use, weak institutional capacity, limited infrastructure, limited capacity and equipment for disaster management, limited financial resources and low income per capita and heavy reliance on rain-fed agriculture (MWLE 2002).

Action Aid's fieldwork confirms that climate-induced declines in crop production are already happening in Uganda today. In the face of this threat, farmers have begun to respond to failing crops and increased hunger by adopting sustainable, low-input agriculture techniques that increase their food security ([www.actionaid.org](http://www.actionaid.org)).

### **1.3 Impacts of climate change and variability in Uganda**

The impacts of climate change create challenges and impose severe losses and hardships on the poorest communities as their livelihoods are likely to be more sensitive to adverse climate change. The most dominant and widespread disaster due to climate change is drought, whose frequency is observed to be on the increase, for example seven droughts were experienced in Uganda between 1991 and 2000 (GOU, 2007). Drought has severely affected the agricultural sector leading to impacts such as famine, malnutrition, low production and productivity of crops and animals, etc.

Climate change also affects the availability of water resources by depleting underground and surface water potential. Prolonged and severe droughts lead to low water levels in water bodies, underground aquifers and reservoirs, affecting the hydrology, biodiversity and water supply (GOU, 2007). Although Uganda has abundant water resources, its distribution is uneven. The semi-arid areas of the country stretching from southwest through central to the northeast of the country experience chronic water stress. The prolonged drought of 1999/ 2000 caused severe water shortage, leading to loss of animals, low production of milk, food insecurity, increased food prices, and a general negative effect on the economy (GOU, 2007). On the other hand, floods also have negative effect on crop production and water resources; floods may lead to crop failure and pollution of drinking water sources leading to outbreaks of waterborne diseases such as cholera, typhoid and dysentery due to poor sanitation. A large proportion of the rural poor do not have pit latrines/ toilets.

Changes in temperature have also had significant impacts on health and agriculture. Due to temperature rise, mosquitoes have invaded the highlands and malaria is now prevalent in these

areas which were previously malaria-free. According to GOU (2007), there was a general increase of malaria incidences throughout the country, particularly southwestern Uganda where it reached epidemic proportions during 2007. Data from health units in the districts of southwestern Uganda in 1996, 1997 and 1998 reveal an increase in the cases of malaria cases raging from 23% in Rukungiri to 135.5% in Mbarara district (Ministry of Health, 1998). The country has also seen unprecedented outbreaks of pests and diseases, such as the Coffee Wilt Disease, Banana Bacterial Wilt, etc. that are likely to be a consequence of climatic changes.

Uganda's ecosystems are also changing and biodiversity loss is on the increase due to extreme droughts and unsustainable agricultural practices. Disappearance of plant species, particularly medicinal plants and pastures have been observed. Wildlife and other natural resources depletion is a clear indicator of climate change. Climate change also causes changes in vegetation type, crop types and varieties, forest resources, soil conditions, and water levels. Dry conditions and prolonged droughts frequently lead to outbreaks of fire that degrade forests resulting into serious environmental consequences. Highland and semi-arid ecosystems are the most vulnerable to biodiversity loss. Climate change also impacts negatively on other key sectors and therefore on the socio-economic development of the country.

Human induced climate change is likely to increase average temperatures in Uganda by up to 1.5 °C in the next 20 years and by up to 4.3 °C by the 2080s. Such rates of increase are unprecedented. Changes in rainfall patterns and total annual rainfall amounts are also expected but these are less certain than changes in temperature (IFPRI – TerrAfrica, 2009). Regardless of changes in rainfall, changes in temperature are likely to have significant implications for water resources, food security, natural resource management and human health.

#### **1.4 Impacts of climate change and variability in the Karamoja sub region**

Although all the agro-ecological zones of Uganda are grappling with the effects of climate change and variability, the Karamoja sub region is most affected. This is attributable to the fact that it is the least socially and economically developed in Uganda, even among the generally poorer parts of northern Uganda as a whole (GOU, 2009). It is characterized by a combination of acute poverty, vulnerability to drought, poor infrastructure and basic services delivery, limited marketing opportunities, natural resource degradation, social and cultural marginalization, long-standing dependency on external aid and most importantly chronic insecurity (GOU, 2009).

In addition to the above challenges, the region is also chronically food-insecure because of generally low rainfall amounts, and poor distribution and reliability plus inherently low soil fertility (GOU, 2009). Unlike the rest of the country with a bimodal rainfall pattern, Karamoja has a mono-modal rainfall pattern with one planting season (Musiitwa and Komutunga, 2001; GOU, 2009). The general rainfall pattern is one of rainfall commencement in April and cessation in September. The period of effective plant growth is only from April to the end of August, because intense drought extends from November to the end of March (Wilson, 1960; Musiitwa and Komutunga, 2001). However, this pattern is not reliable and in many years the rains are sparse, or fail altogether (Musiitwa and Komutunga, 2001). Thus, drought and hunger are recurrent features of life in Karamoja.

Temperatures are high, ranging from a maximum of 28°C to 32.5°C to an average minimum of between 15°C to 18°C. In the entire region, there is no month when rainfall exceeds potential evaporation therefore optimum crop output can be obtained only with additional water supply (GOU, 2004). The soil productivity in the greater part of the area is characterized as low with a few series characterized as medium (Wilson, 1960). The dominant soils are black clays and dark grey clay and although they are low in organic matter, they have a medium moisture storage capacity, which may be productive when irrigated (Musitwa and Komutunga, 2001). Soil erosion in varying degrees is widespread in the region, it is chiefly dependant on topography, climate, soil type, and man (Wilson, 1960).

These environmental and edaphic factors have direct bearing on the kind of activities and the livelihoods of the people in the sub region. In many areas rains do not exceed 800 mm per annum, but sometimes it is a mere 500 mm. In that regard, the majority of the population leads a pastoral or agro-pastoral lifestyle.

Since 2001 there has been an increase in extreme weather patterns in the region resulting in extended dry spells every second or third year (2002, 2004, 2006, and 2009) or floods such as those experienced in 2007. Moreover, climate variability/ change is projected to continue manifesting through extreme weather conditions (GOU, 2007). These cyclic extreme weather conditions (droughts, erratic rainfall, floods) have affected crop production and pasture for livestock in the region, thereby having a direct negative effect on the livelihoods of the population. The extended dry spells exert pressure on water availability in most parts of the region (GOU, 2009). Moreover, there are no permanent rivers in the region and only a handful of permanent springs (located in the mountains).

The region suffers severe environmental degradation, poor infrastructure and high prevalence of diseases such as malaria and diarrhea among children, poor health practices, and poor sanitation conditions. Coupled with high poverty levels, the situation has eroded people's coping capacity, leaving them in a precarious vulnerability state (GOU, 2009).

Prolonged dry spells have caused dust storms leading to outbreaks of respiratory disease and eye infections. Climate change may lead to reduction in food production with serious consequences of malnutrition, particularly in children. This is projected to lead to impaired child development and decreased adult activity. This will in turn lead to severe reduction in economic productivity.

## **2.0 OBJECTIVES OF THE CONCEPT NOTE**

The GOU has prioritized policy and implementation efforts related to climate change adaptation efforts in the following key sectoral areas:

- Agricultural production and development which is better adapted to climate change-related risks and does not itself contribute towards climate change
- Water resources management and protection to reduce vulnerability to irregular rainfall patterns

- Ecosystem and environmental protection from encroachment and habitat destructions, including forests and wetlands that play a key role in limiting various climate-change related threats
- Health sector response aimed at preventing and/ or responding to increased health-related threats linked to climate change risks.

This study was designed to contribute to the efforts of the FAO and United Nations Joint Action Framework on Climate Change in Uganda (UN-JFCC). The mandate of the UN system within the UN – JFCC is to support Uganda’s effort to prioritize climate change adaptation efforts in the above sectoral areas. Currently there is no systematic documentation or compilation of adaptation measures based on clearly defined “adaptation” criteria. Also there is no mechanism or recommendations for mainstreaming adaptation measures or issues in the emergency and regular program sector strategies and operations in Uganda.

This study attempted to fill this gap. This is in line with the ultimate goal of FAO to inform and promote local dialogue about what the impacts of climate change are likely to be and what options exist for reducing vulnerability and to provide local communities with site-specific solutions.

More specifically the study:

- analyzed existing information on climate change scenarios and their impact on the livelihood strategies of the people in the sub region
- conducted field assessments to confirm impacts of climate change on local communities and also assessed on-going adaptation measures/ technologies being used.
- identified and compiled climate change adaptation measures (policy and technical) and recommended ways by which they can be mainstreamed both in the emergency and regular development program sector strategies and operations in Uganda.
- analyzed outreach methodologies used by different players in the sub region and made recommendation on the best outreach strategy/ plan taking into account the socioeconomic realities in the sub region.

## **3.0 METHODOLOGY**

### **3.1 Scope of the study**

The study focus area was the Karamoja sub region focusing on its three key livelihood zones (agro-ecological zones): pastoral, agro pastoral, and wet (agricultural) zone, which are spread across five districts namely Abim, Kaabong, Kotido, Moroto, and Nakapiripirit (Fig. 1) plus the newly created Amudat and Napak districts carved out of Moroto and Kotido districts, respectively.

### **3.2 Methods and Tools**

The study was conducted using the following approach and methodology:

### 3.2.1 Literature Review

The Study Report was prepared basing on existing general literature, among them, Climate Change: Uganda National Adaptation Programmes of Action, 2007; Karamoja Action Plan for Food Security (2009 – 2014) by the Office of the Prime Minister; Karamoja Participatory Livestock Needs Assessment, November 2006 by FAO; Agriculture in Uganda, 2001; Turning up the heat: climate change and poverty in Uganda by Oxfam; The time is now: lessons from farmers adapting to climate change by Act!onaid; etc. These amongst others, were very useful in the preparation of this Concept Note.

### 3.2.2 Rainfall data

The rainfall data used in this study consisted of daily rainfall records for the period 1961 – 1985 from the Kotido Station, representing one of the 10 agricultural production zones (GOU, 2004) and 14 rainfall zones of Uganda (Basalirwa, 1991). The bulk of the daily data was obtained from the Uganda Meteorological Department with some data also directly obtained from the recording station (Kotido). Trend analysis for daily rainfall (1947 – 2000) was constructed using Genstat discovery version.

**Figure 1: Karamoja and its districts**



### 3.2.3 Field Assessments

Field assessments were done by visiting all the districts in the sub region to assess the impact of climate change on the local communities and the adaptation options at their disposal. Information

of endowment profiles including physical, social, economic, land use and indigenous knowledge on climate change and variability adaptation/ mitigation were obtained through consultative discussions with various stakeholders such as: district local authorities, officials of relevant NGOs, key community leaders, and grassroots communities using focus group discussions.

### **3.2.4 Limitations and challenges**

There were a number of limitations and challenges regarding the accomplishment of this assignment. The following were considered the most important:

One of the major problems encountered was the paucity of climatic data for the sub region especially the temperature data. This was so minuscule that it could not be used for any meaningful analysis. In addition, the country still lacks sufficient capacity in the area of meteorology to undertake intricate climatic data analysis. There are also not enough robust tools for analyzing climatic data. Lastly, there is relatively little in-depth materials published regarding the current human security and livelihood strategies of the Karimojong people.

## **4.0 FINDINGS**

### **4.1 Bio-physical environment and other related information of the study area**

#### **4.1.1 Broad Agro-Ecological Zones of Uganda**

The general agro-ecological zones of Uganda are shown in Annex I and the overall rainfall distribution in the country is shown in Annex II. Additional information on the two broad agro-ecological zones that cover the study area is shown in Annex 3. The study area is located within two broad agro-ecological zones (Zone I & II) in the Uganda overall agro-zoning (Annex III). These are:

- North Eastern Drylands
- North Eastern Savannah Grasslands

#### **4.1.2 Location of the study area**

Karamoja sub region (Fig. 1) is located in the northeast of Uganda and lies between longitudes 33 – 35 East and latitude 1 – 4 North. Currently it comprises of seven districts: Abim, Amudat, Kaabong, Kotido, Moroto, Nakapiripirit, and Napak.

#### **4.1.3 Area coverage and resources endowment**

The sub region covers 27,511 km<sup>2</sup> most of which is semi-arid savannah covered with seasonal grasses, thorny plants, and occasional small trees and mountains. The UBOS Population Projection of 2008 gave a total population of 1,017,400 for the region with 50% female. Eighty percent of the total population is estimated to be living below the poverty line (UNDP, Human Development Report Uganda, 2007) relative to the national average of 31%. Human welfare, living conditions, and quality of life of the people in Karamoja have declined considerably due to a combination of factors e.g. harsh weather, insecurity, marginalization, illiteracy, poor health, poor infrastructure, etc. Some of the districts in the sub region e.g. Moroto and Nakapiripirit have the lowest HDI (Human Development Index) of 0.183 as compared to the national average of 0.4491. Furthermore, the districts of Karamoja also have the highest Human Poverty Indices (HPI) with Nakapiripirit and Moroto districts having 63.5% on average compared to the national average of 37.5%. The region has some of the worst indicators for health, nutrition, education, food security, civil security, and poverty.

The region has two main ethnic groups: the Karamajong and the Jie. Other smaller groups such as the Pokot (Eastern Karamoja), Labwor (Western Karamoja), Ik and Dodoth (Kaabong), and Tepeth and Matheniko (Moroto) also exist.

Set on a large plateau, much of Karamoja is more than 1,000 masl (GOU, 2009). It is semi-arid with the majority of the population leading a pastoral or agro-pastoral lifestyle, relying on livestock as its main source of subsistence (GOU, 2009). In years of adequate rainfall the people in this region grow sorghum, millet, cowpeas, groundnuts, etc. They supplement their food supply by gathering wild fruits and vegetables and through hunting. However, most people have adapted to the harsh environment by raising livestock (cattle, goats, sheep, etc.) with crop cultivation taking a more subsidiary role (FAO, 2008/09). This according to the Poverty Reduction Development Plan (PRDP) is the only rational way and most viable form of livelihood (FAO, 2008/09). The reliance on livestock has led to overstocking which might be partly responsible for the severe erosion in the eastern parts of the sub region. The natural vegetation of *Acacia-Hyparrhenia* has been overgrazed and shortage of pastures and water leads to nomadic movements south and westwards during the extended dry period, September to April (Musiitwa and Komutunga, 2001). The extended dry spells exert pressure on water availability in most parts of the sub region, with average distance to water for livestock at four kilometers (GOU, 2009). Competition for scarce resources, particularly water and pasture, and the high value placed on cattle have produced a culture of rustling by attacking neighboring tribes and annexing their herds (Quam, 1996; Musiitwa and Komutunga, 2001).

Dependency on livestock carries risks even in the absence of conflicts or drought (FAO, 2008/09). Since 2007, the sub region's livestock, which is an integral element of food security, has been decimated by diseases such as *peste de petitis ruminants* (PPR) [goat plague], and *contagious bovine pleuropneumonia* (CBPP), while staple crops such as sorghum have been hit by crop fungus (GOU, 2009). Disease problems are compounded by physical insecurity, which limits access to drugs and advice (FAO, 2008/09). Physical insecurity has a number of damaging effects on food security. These include loss of livestock, property and human life due to periodic raids. In addition security concerns also reduce access to land for cultivation, and lead to a sense of demotivation. These factors increase the reliance on food aid as the only reliable source of food (FAO, 2008/09).

As a result of the on-going disarmament exercise, there is relative stability in the sub region. Numerous people have lost their cattle, which is their historical livelihood, through incessant raids

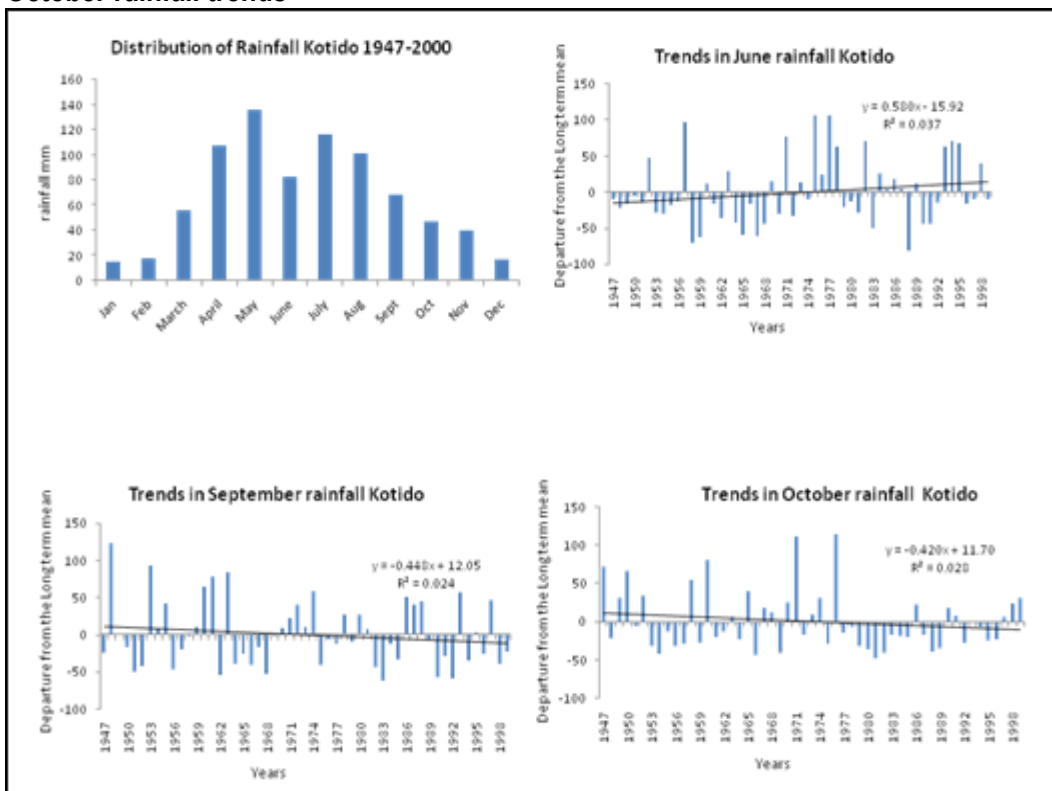
therefore with relative stability prevailing it has triggered population movement from the dry pastoral belt of the northeast and southeast to the wet green belt of the northwest and southwestern in an attempt to engage in settled farming, as a new form of livelihood.

## 4.2 Agro-meteorological climate trends in the Karamoja sub region

### 4.2.1 Rainfall variability

Unlike most parts of the country with a bimodal rainfall pattern, Karamoja has a uni-modal rainfall pattern. This rainfall regime, represented by Kotido Station in Kotido district commences from April to November with peak rainfall during April, May, July and August with laxity of rains during the month of June (Fig. 2). This has been the general pattern for years as reported by Wilson (1960) and Musiitwa and Komutunga (2001) who observed that the rainfall in the sub region is characteristically episodic in occurrence, alternating with a prolonged severe dry season. They further noted that there is considerable variation from year to year in the total annual rainfall and moreover the rainfall is poorly distributed. This observation is well illustrated in Figs. 2 & 3, monthly and annual rainfall variability is quite high but without a consistent pattern. Further analysis shows that the average monthly rainfall in the month of June has been steadily increasing, while average monthly rainfall in the month of September and October shows a declining trend (Fig. 2).

**Figure 2: Average monthly rainfall taken at Kotido Station and the June, September and October rainfall trends**



Although the observed increase in June monthly rainfall is beneficial as it is in the middle of the season, the observed decrease in rainfall at the end of the season is detrimental as it shortens the already short annual length of the potential crop growing period of the region, posing challenges to pasture and crop growing. The annual rainfall also shows a decreasing trend (Fig. 3). Quantitatively, the rains received annually have decreased by about 15 – 20% since the 1960s. According to Anderson and Robinson (2009), average annual rainfall has decreased by about 15%, but the deficit is further compounded by the way in which the rainfall arrives, the intensity and the duration between rainfall events has varied considerably. No longer can periods of reliable rainfall be assumed in one year out of three.

Generally, with a range of 140 to 160 days, the sub region has the shortest annual length of the growing period (Fig. 4). The combination of a uni-modal rainfall regime with poor distribution and high variability and a short annual length of the growing period which is shrinking make the people vulnerable to food insecurity because they have only one unreliable chance in a year to grow their food yet in a very short period and if that chance is lost the people are left in a very precarious situation. That is exactly what has happened in the last 3 – 4 years. Apparently, two scenarios are emerging in the sub region, which are attributable to the global change in climate: **annual rainfall, which is poorly distributed with high variability, is decreasing and the potential crop growing period is also getting shorter.**

According to the GOU (2009), the sub-region has been affected by consecutive years of crop failure and low livestock productivity due to below normal weather conditions. From 2001, there has been an intensification of extreme weather patterns (climate variability/ change) in the sub-region resulting in extended dry spells every second or third year (2002, 2004, 2006, 2009). Cyclic droughts and erratic rainfall have affected crop production and pasture for livestock in the sub region, thereby having a direct negative effect on the livelihoods of the population.

**Figure 3: Annual rainfall variability from 1947 to 1985 in the Karamoja sub region [data source: Kotido Station]**

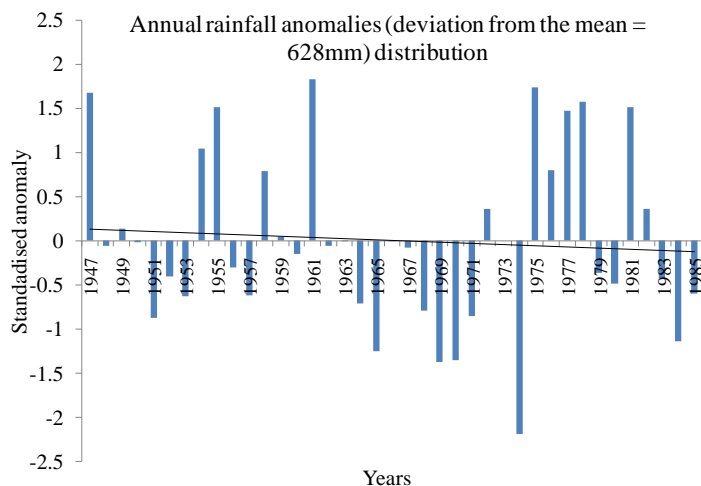
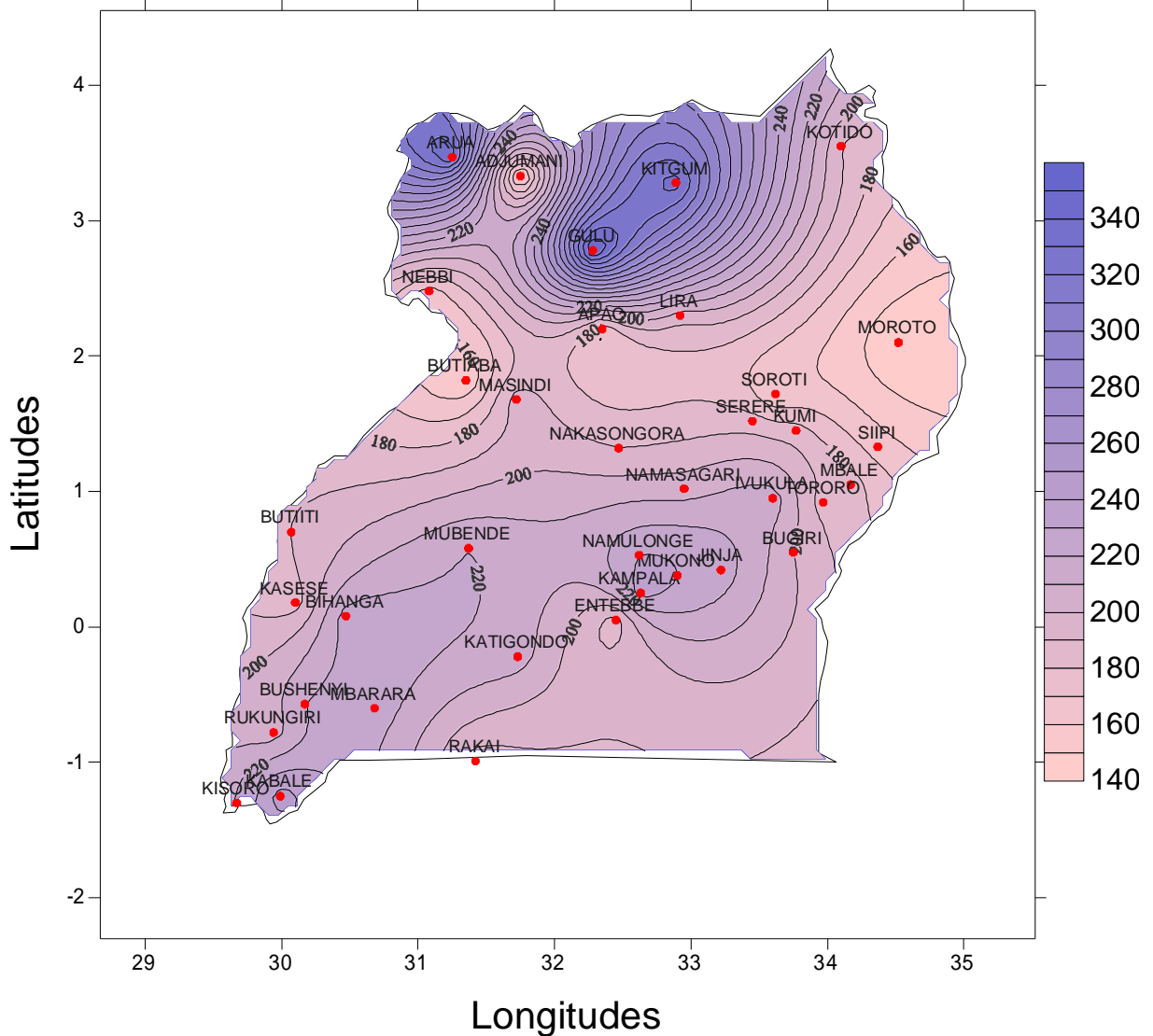




Figure 4: Spatial map displaying the annual length of the growing period over Uganda

### Annual length of the growing period over Uganda



#### 4.2.2 Temperature variability

Uganda in general experiences moderate temperatures throughout the year; the mean daily temperature is 28°C. Highest temperatures (over 30°C) are experienced in the north and northeastern part of the country (GOU, 2007). Sustained warming particularly over the southern parts of Uganda has been documented (GOU, 2007). The fastest warming regions are in southwest of the country where the rate is of the order of 0.3°C per decade (GOU, 2007). Average daily temperature records from 1950 up to 2008 from Namulonge Station, central Uganda show an increase in temperature (Fig. 5). However, the minimums of the daily maximums are changing faster than maximums and the minimums of the daily minimums are also changing faster than the

maximums. The implication of this is that the day and night temperatures are becoming warmer (Mubiru et al., 2009). The surface temperatures in the Karamoja sub region are already documented to be high (Musitwa and Komutunga, 2001; Wilson, 1960) therefore any slight increase is likely to aggravate the situation. A temperature increase for the sub region could not be ascertained due to paucity of temperature data from the sub region.

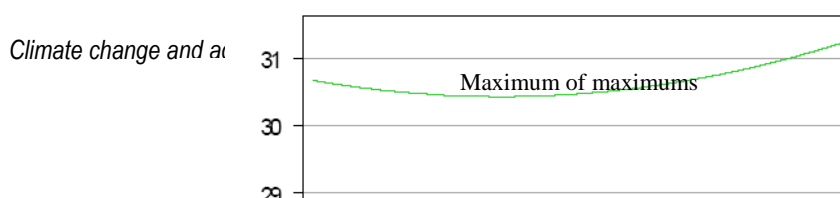
The documented and projected increase in temperature is likely to exacerbate the delicate situation of water balance in the sub region with significant implications for water resources, food security, natural resources management and human health. Other impacts of increase in temperature in the sub region include wild fires leading to destruction of natural vegetation and biodiversity. The impacts of climate change/ variability in the sub region in the agricultural, water, health, and environmental sectors are listed in Table 2.

There is need for in-situ water conservation by either employing technologies such as conservation agriculture with one of its principles being keeping the soil covered almost throughout the year through the use of cover crops or mulch. In a study conducted in the semi-arid areas of Kenya, Cooper et al. (2009) observed that mulching could increase the length of the growing period by 13 days from 110 days. Its benefits notwithstanding, the problem with mulching is the source of the mulching materials most especially in dry areas where biomass production is low.

**Table 2: Impacts of climate change/ variability in northeastern Uganda in the agricultural, water, health and environmental sectors**

Sector	Impact	Effects of the impact
Agriculture production and development	Drought	Crop failure, low productivity, poverty
	Flash floods & flooding	Soil erosion & land degradation, crop damage, infrastructure damage
	High temperatures	Soil water stress, low productivity
	Pest and disease epidemics	Low production and productivity of crops and livestock
Water resources management and protection	Drought	Drying up of rivers ; Water scarcity, transhumance, low productivity, resource use conflicts
	Heavy rains, storms, floods, change in river flow regimes	Flooding, infrastructure damage, water pollution
	High temperatures	High loss of water through evapo-transpiration (valley dams & crops)
Health	Famine	Insufficient food, malnutrition, deaths
	Prolonged dry spells and dust storms.	Increase in respiratory, chest and eye infections
	Flooding	Disease epidemics, direct loss of lives
Ecosystem and environmental protection	Drought	Fire risks, land degradation, destruction of natural vegetation, biodiversity loss
	Flooding	Soil erosion and land degradation, biodiversity loss
	High temperatures	Wild fires and burning leading to destruction of natural vegetation and destruction of biodiversity

**Figure 5: The trend of maximum temperatures from 1950 to 2000 [source: Namulonge Station, central Uganda]**



The observed variations in rainfall and increase in temperature may be due to natural processes within the climate system observed over comparable time periods or to natural forces or anthropogenic activities which alter the composition of the global atmosphere.

### **Possible drivers of climate change**

In their survey in Moroto district, Majaliwa et al. (2009) listed the following biophysical changes as reported by the respondents: deforestation and tree-cutting, reduced soil fertility, more erratic rainfall, more frequent droughts, reduced vegetation cover/ pasture, etc. Deforestation and tree-cutting, both of which affect carbon stocks which is one of the contributing factors to climate change/ variability have increased significantly in the past 30 years. About 25% of Uganda's forest cover was lost between 1990 and 2005 (NEMA, 2007). According to Mugisha (2002), charcoal burning is one of the leading causes of deforestation in the dry areas of Uganda. Indeed charcoal burning/ firewood were top on the list as alternative sources of livelihood in most of the communities visited (Box 1 – 3). Reduced soil fertility is a major problem affecting agricultural productivity and soil nutrient depletion in Uganda is reportedly among the highest in sub Saharan Africa (SSA) (Storvogel and Smaling, 1990). Land degradation in the sub region is largely due to over grazing, which lead to soil erosion (NEMA, 2007).

The actual number of livestock in the sub region is not easy to ascertain due to cultural, security, and other factors, however it is estimated that Moroto district alone is home to the largest cattle population in Uganda, with 16% of the 5.18 million cattle population (NEPAD & FAO, 2004). The high number of livestock with poor farming/ grazing practices e.g. high concentration of livestock in one place (protected kraals), nonuse of soil and water conservation physical structures, etc. is causing overgrazing and land degradation.

As internal insecurity has increased within the sub region, access to key grasslands and watering holes has decreased. Some communities are separated by large tracts of land with abundant

vegetation and tree life as such areas are too insecure for regular grazing or collection of natural resources. This point is well illustrated by the stretch from Lorengedwat to Nabilatuk, Nakapiripirit district through Amudat, locally referred to as the '**conflict corridor**'. This stretch has lush vegetation/ grass because it is not utilized for grazing due to insecurity in the area. The Bokora reportedly attack neighbouring communities regularly.

In addition, due to insecurity the manyattas that were once scattered are now closer together and home to larger populations, both human and livestock. The kraal system has also changed over time, with people creating larger kraals for the purpose of increased protection. All these have an impact on land management.

#### **4.2.3 People's perceptions of climate change**

One of the prerequisites to adapt to change is recognition that actually change is taking place. In the case of climate change, farmers must first perceive that changes are in fact taking place (Mubiru et al., 2009). In their survey in Moroto and Nakapiripirit districts, Mubiru et al. (2010) reported that an overwhelming majority (96% of respondents from both districts) perceive that there have been changes in the weather patterns. Only 4% of the respondents indicated that they were not aware of any changes in the weather patterns. The three most important changes reported by respondents were no rainfall, changes in rainfall patterns and increases in temperature. Eighty two percent of the respondents from Moroto district reported that changes have manifested themselves through no rainfall compared to only 42% from Nakapiripirit district (Fig. 7). About the same number of respondents from both districts (18 & 17% from Moroto and Nakapiripirit district, respectively) reported that the changes have involved alteration of the rainfall pattern; while 28% of the respondents from Nakapiripirit district reported that the changes have presented themselves through increases in temperature.

Apparently, the respondents' perceptions are consistent with the actual climatic data. Regarding rainfall amount, data show that the average annual rainfall is on the decrease and the potential crop growing period is also shrinking which is well collaborated by an overwhelming majority of respondents (62-%) reporting less rainfall. Rainfall in the sub region has generally decreased for the rainy season (March – August) from its levels in 1981 – 1985 (Majaliwa et al., 2009). Regarding the change in the rainfall pattern, besides the high variability to which the perceived change could be ascribed, there is also the increasing trend in the June rainfall and the decreasing trend in the September and October rainfall.

Farmer perceptions regarding changes in rainfall characteristics such as onset and seasonal distribution are presented in Figures 6 & 7. Perceptions of rainfall onset were divided into two categories: late and variable (i.e. sometimes early while other times it is late) (Fig. 6). Since there were no significant differences between the two districts in the percentage of respondents citing each category, data for the two districts was averaged. According to the results, the majority of respondents (62%) recognize that the rainfall onset is now late while 38% reported that onset is variable. It is probable that the increasing trend in rainfall amounts for the month of June have made people in the area perceive that the onset of rains has shifted from April to June, thus late onset.

## **Box 1: Case Scenario 1 – Lorikokwa village, Nadunget sub county, Moroto district**

### **Changes in the weather patterns**

In this community, members indicated that in the past there were clear differences between wet and dry seasons but in the last five years seasons have not been clear. This has distorted the cropping calendar with serious impact on food security. The current state of affairs is attributed to nature/ gods. There has been an attempt to appease the gods but to no avail.

The community members reported that 2010 generally has been a good year in terms of rainfall amount and distribution as evidenced by the sorghum shambas from the south in Nakapripit district to the north in Kaabong district and across from Moroto to Abim district. However, the community reported that the sorghum is not good in taste and the crop was being destroyed by bees. These are new sorghum varieties. Due to the incessant droughts leading to crop failure, farmers have lost their own seed of the local crop varieties and are now growing new varieties supplied by either government or NGOs. The favorite local sorghum varieties include *Naterekune* and *Loyokou*

### **Coping mechanism**

The community reported that they cope with droughts by digging water pans in riverbeds for obtaining water.

### **Alternative livelihoods**

The community reported cutting trees for firewood and making charcoal as an alternative livelihood, however, this is associated with conflicts and ambushes from warriors. The best trees for firewood include *Etirir*, an acacia; *Ekorete*, *Ekodwolodwo*

### **Indigenous knowledge regarding weather/ rainfall forecasting**

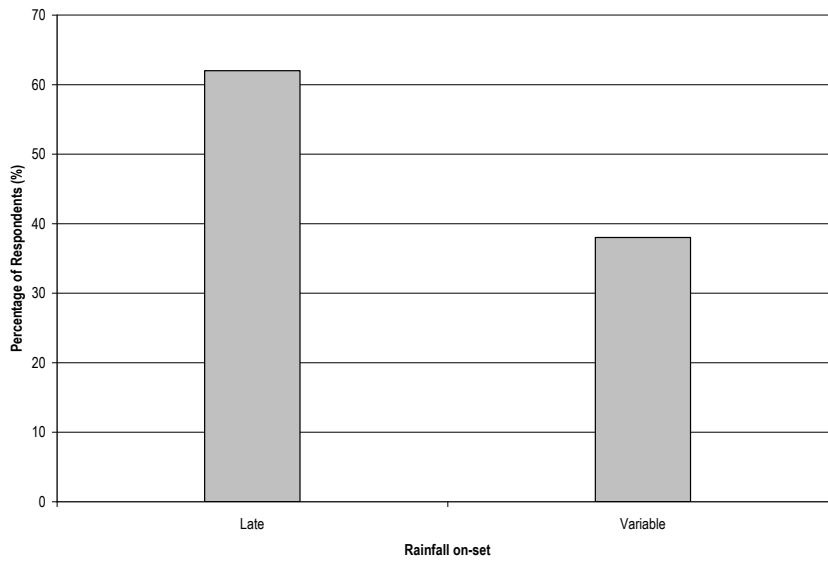
The community reported several mechanisms for weather forecasting e.g.

- A certain appearance of animal intestines might indicate disaster/ drought
- Dreams of key community leaders can also help in weather forecasting
- The appearance of a certain star (*Lomoroko*); if this star appears at 5 am in the morning it is an indication of drought to come
- When animals kneel to drink is also an indication of drought to come
- Light ghee is another indication of drought
- Sorghum failing to ferment is also another indication of drought

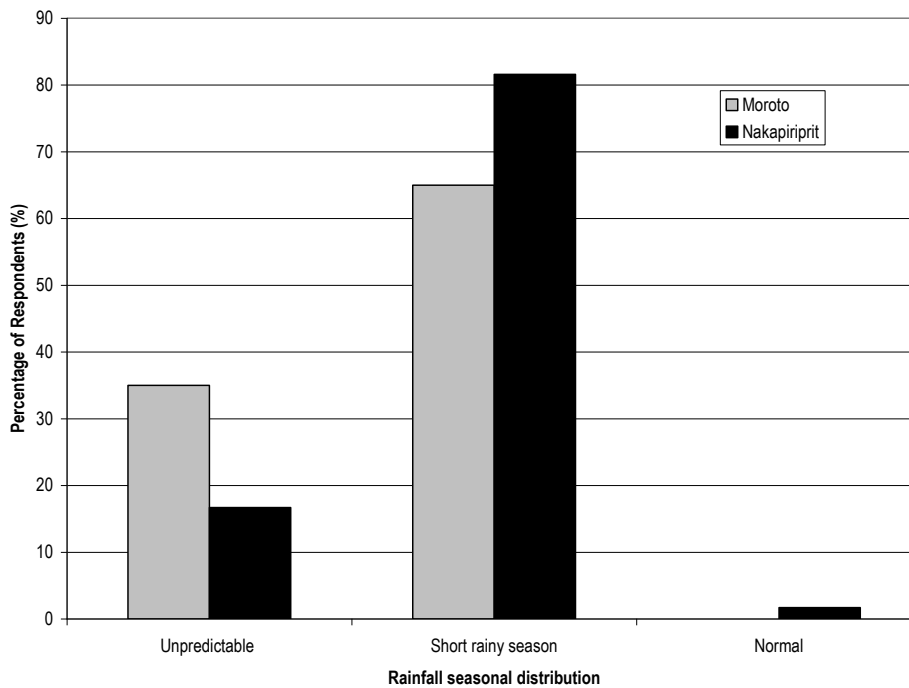
### **Interventions**

The community has embarked on growing vegetables and fruit trees, including mangoes and citrus.

**Figure 6: Respondents' perception of rainfall on-set [adopted from Mubiru et al., 2010]**



**Figure 7: Respondents' perception of rainfall seasonal distribution [adopted from Mubiru et al., 2010]**



Perceptions regarding rainfall distribution were divided into three categories: unpredictable seasonality, short rainy season, and normal distribution (Fig. 7). The majority of respondents from each district reported that the season is now shorter than before; while a small percentage from Nakapiriprit district reported that the rainfall distribution is normal. The empirical data tends to

support the majority as it points to a decreasing trend in the September and October rainfall, both months at the tail-end of the growing season which is causing the potential crop growing period to shrink.

**Box 2: Case Scenario 2 – Nabokotom village, Amudat sub county, Amudat district [mainly Pokot clan]**

**Changes in the weather patterns**

According to this community, drought has always been there. Reportedly, several other communities in this area are not aware of climate change; that is, deviations are not remarkable because since 2003 it has been dry.

Most community members attribute the lack of rain to nature. During the days of insecurity some human activities ceased or were restricted but when peace set in it led to increased human activities e.g. encroachment on forests and tree cutting for firewood and charcoal making as alternative livelihoods. Due to peace, other people are coming to settle in the area, which is also causing more degradation.

**Community challenges**

High human population

Small livestock numbers due to animal diseases e.g. tick borne diseases and cattle rustling. The community uses local herbs e.g. aloe vera and *sokwon* tree for treatment of tick borne diseases. That notwithstanding, there are several livestock disease probably as a result of drug resistance which has made it difficult to control the diseases.

**Adaptation option**

- Irrigation
- Migration in search of food and pasture – migration usually takes place during the month of July. However, this year (2010) there has been some rain and animals are still around due to presence of pasture and water
- Settling along the wet corridors & cultivation along the river banks – however, too much rain brings floods as happened this year
- Agro forestry (Aloe vera, trees, etc)

**Alternative livelihoods**

- Stone quarrying
- Fetching water for sale and collecting and selling firewood – mainly by women [there are by-laws to restrict trade in charcoal but reportedly it is not effectively enforced].
- Cutting trees for charcoal and firewood
- Aloe Vera enterprise

**Communication/ information dissemination**

Implementation of projects is best through the community/ farmer groups. NAADS and ZOA, a Dutch NGO are the most visible projects in the area.

These perceptions are collaborated with empirical meteorological data. The average annual rainfall at the Kotido Station is about 628 mm. However, from the mid 1960s up to 1985 standardized rainfall anomalies<sup>3</sup> have been below the average while previously the standardized anomalies were

<sup>3</sup> The standardized anomaly is a measure of how widely spread the rainfall is from the mean

above the average (1940s up to mid 1960s) (Fig. 4). This probably explains the frequent droughts and chronic food insecurity of Karamoja and the fact that the Karimojong heavily rely on relief food handouts. Since 1964 the Karimojong have relied on relief food handouts year in year out (GOU, 2009). According to Musiitwa and Komutunga (2001), over the last 29 years, seven have seen complete crop failures throughout the districts while on nine other occasions, yields have been poor.

**Box 3: Case Scenario 3 – Karinga village, Moruita sub county, Nakapiripirit district [community comprised of a mixture of Pokot and other Karimojong clans]**

**Changes in the weather patterns**

The community acknowledged that there have been changes in the weather pattern, which they attributed to the rampant cutting of trees. The main source of livelihood is agriculture, the main crops grown being: maize, beans, cassava, sweet potatoes, groundnuts and cabbage. The local maize (*nylon*) does not perform well any more, but hybrid maize especially DK 888 is doing very well in the area. However, the problem with the hybrid maize is that farmers have to buy new seed every season. The bean variety K120 was also reported to perform well in the area.

Visible NGOs in the area include IRC (supplied groundnuts), IOM (in vegetable enterprises)

**Community challenges**

- Insecurity prevents people from working in their gardens and grazing their animals
- Lack of knowledge on animal diseases
- Seeds are not delivered on time, usually they come several months after the onset of rains
- There were also reports of supply of expired seeds

**Coping mechanisms**

Utilization of wild vegetables e.g. *Edowol* and *Lobolia*

**Alternative livelihoods**

- Collection of forest products for sale e.g. *mirungi*, a narcotic, from the Nakapiripirit hills
- Sale of charcoal, firewood and grass for thatch

**Communication/ information dissemination**

It is best to work with farmer groups, approached through key community leaders.

All respondents (100%) from Nakapiripirit district reported that currently the temperature (weather) is very hot. In Moroto district, 90% of the respondents reported the weather to be very hot while 10% reported that the weather was favorable. Empirical climatic data on temperature (Fig. 5) indeed shows that there has been an increase in temperature and the increase is still continuing. However, the fastest warming regions are reportedly in southwest of the country. Whether the people's perception regarding temperature in the northeast is real increase is hard to ascertain due to the paucity of data and the fact that the temperatures in this region were already the highest in the country. Unless proven with empirical data it is likely that the temperature in the sub region might still be the same as those in earlier years but the increased frequency of droughts and increased length of the dry periods make people feel as those the temperatures are on the increase.

#### **Box 4: Case Scenario 4 – Teramoth village, Pupu Kamuya Parish, Nyakwayi sub county, Abim district**

##### **Changes in the weather patterns**

According to this community, there have been some slight changes in the weather pattern, for example, this year rains started in April but disappeared in May and June was completely dry. With rains, however, the harvests are good as the soils are reportedly still productive. The community claims to have plenty of land, with average land holding estimated as 1 ha. The main crops grown are: sorghum, groundnuts, sesame and sunflower, which are mainly grown for subsistence as there are no outside traders. They also keep livestock in small numbers. The community claimed not to have experienced any new diseases beside the common ones e.g. malaria. They reportedly use local herbs for the treatment of malaria; these include *Abach* and *Neem* tree (Indian leaves).

The main source of water is boreholes: Pupu Kamuya parish has an estimated population of 1,900 which is served by two boreholes. The area also experiences seasonal rivers.

##### **Community challenges**

- Striga weed is a problem, especially on sorghum production
- Termites also reportedly pose a serious challenge
- Cassava could do well in the area but the community lacks planting materials and they claim that once grown warriors/ raiders come and steal it.
- Besides WFP which provides food aid, there is no other NGO working in the area, thus there is no help with agricultural enterprises

##### **Coping mechanisms**

The means of survival are limited – during food scarcity the community mainly depends on food aid for survival. However, they have a few natural resources at their disposal e.g.

- coconut (*Tugo*) – not very palatable
- wild yam (omwodu)

##### **Alternative livelihoods**

- Harvesting and sale of bamboo poles for house construction
- Harvesting and sale of grass for thatching houses
- Brick making
- Stone quarrying

##### **Communication/ information dissemination**

Gatherings especially in church are the best forums for information dissemination. Other means of information dissemination include radios and cell phones. The best time for radio programs was indicated to be during prime time (news hour) – 7:00 am, lunchtime (1:00pm) and 8:00 pm. Communication through cell phones is limited as some households do not have sets.

#### **4.2.4 Consequences**

Adverse impacts of climate change in Uganda include drought, famine, flash floods and flooding, devastating landslides (in February, 2010; 350 people were killed by landslides in Bududa - Eastern Uganda; three villages were buried by the mud/ landslide and several people were killed in Kabale – Western Uganda; Butaleja district was extensively flooded), water scarcity, prolonged dry spells and dust storms, among several others. Climate change impacts undermine health and well-

being, the economy and overall development of the country. Food insecurity is a major challenge and climate change impacts are making food insecurity worse. Impacts are greatest on the lives of ordinary people, especially women, frustrating their efforts to overcome poverty (Magrath, 2008).

The impacts (hazards) due to climate change and the associated vulnerabilities in the study area include:

**Drought** – frequent and prolonged droughts plus dry spells interspersed within the rainy season can have serious impacts on the livelihoods of the rural communities. Drought is cited as the most dominant and widespread impact of climate change in Uganda, more pronounced and severe in the semi-arid areas of which the study area is part (GOU, 2007). According to Hannah Longole the Program Officer CMDRR, ‘**drought is the main hazard which catalyses other hazards such as famine and insecurity**’. The effects of drought are listed in Box 5.

**Box 5: Effects of drought on agricultural production and development, water resource management and development, ecosystem and environmental protection, and health**

<b>Agricultural production and development sector</b>
<ul style="list-style-type: none"> <li>• Crop failure</li> <li>• Low productivity</li> <li>• Malnutrition</li> <li>• Poverty</li> </ul>
<b>Water resource management and development sector</b>
<ul style="list-style-type: none"> <li>• Water scarcity</li> <li>• Transhumance</li> <li>• Resource use conflicts</li> </ul>
<b>Ecosystem and environmental protection sector</b>
<ul style="list-style-type: none"> <li>• Fire risks</li> <li>• Land degradation</li> <li>• Destruction of natural vegetation</li> <li>• Biodiversity loss</li> </ul>
<b>Health sector</b>
<ul style="list-style-type: none"> <li>• Dust storms</li> <li>• Respiratory, chest and eye infections.</li> </ul>

**Heavy rains, storms, floods** - in recent years the study area like the rest of the country has witnessed increasingly erratic rainfall patterns, and when the rain comes it is heavier and more violent. This has led to flash floods, flooding and change in river flow regimes. According to GOU (2007), heavy rains, storms and floods are only second to drought in importance as they negatively affect all key sectors. The effects of heavy rains, storms and floods are listed in Box 6.

**Box 6: Effects of heavy rains, storms and floods on agricultural production and development, water resource management and development, ecosystem and environmental protection, and health**

<b>Agricultural production and development sector</b>
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<ul style="list-style-type: none"> <li>• Crop damage</li> <li>• Soil erosion and land degradation</li> <li>• Infrastructure damage</li> </ul>
<b>Water resource management and development sector</b>
<ul style="list-style-type: none"> <li>• Water pollution</li> <li>• Infrastructure damage</li> </ul>
<b>Ecosystem and environmental protection sector</b>
<ul style="list-style-type: none"> <li>• Soil erosion and land degradation</li> <li>• Biodiversity loss</li> </ul>
<b>Health sector</b>
<ul style="list-style-type: none"> <li>• Pests and disease epidemics</li> </ul>

### **High temperatures -**

Most parts of the study area experience the highest temperatures (over 30°C) in Uganda (GOU, 2007). Higher temperatures are likely to exacerbate the already precarious situation in the study area. Soil water stress is the main effect of high temperature in the agriculture production and development sector. In the water resources management and protection sector the effect of high temperature is responsible for the drop of water levels in water bodies contributing to water scarcity and the attendant problems such transhumance, conflicts, etc. Effects of high temperatures on the ecosystem and environmental protection sector include wild fires and burning leading to destruction of natural vegetation and destruction of biodiversity.

### **Pest and disease epidemics -**

Climate variables control the geographical distribution of pests and diseases, and therefore expand their distribution to new areas. Climate change induced escalation in epidemics of pests and diseases were reported across districts in human, livestock and crop as major causes of low productivity. This impact poses serious health problems and can significantly affect social and economic programs.

Table 2 shows the climate change impacts to which Uganda is most vulnerable and the effects of the impacts in different sectors in the study area.

## **4.3 Adaptation needs and practical measures for emergency and regular development programs in Uganda**

Adaptations are defined as adjustments or interventions which take place in order to manage the losses or take advantage of the opportunities presented by a changing climate (IPCC, 2001). It is the process of improving society's ability to cope with changes in climatic conditions across the timescales, from short term (e.g. seasonal to annual) to the long term (e.g. decades to centuries) (Nhemachena and Hassan, 2007). The IPCC (2001) defines adaptive capacity as the ability of a system to adjust to climate change (including climate variability and extremes), to moderate potential damages, to take advantage of opportunities, or to cope with the consequences. The goal of an adaptation measure should be to increase the capacity of a system to survive external shocks or change (Nhemachena and Hassan, 2007).

Climate change is projected to have greater negative impacts on poor farm households as they have the lowest capacity to adapt to changes in climatic conditions (Nhemachena and Hassan, 2007). Adaptation measures are therefore important to help these communities to better face the adverse impacts and associated effects of climate change. Adaptation has the potential to significantly contribute to reduction in negative impacts from climate change as well as other changing social economic conditions. The right strategies to adapt to climate change will also be the ones to contribute to sustainable development and to reduce poverty, if properly implemented (Magrath, 2008). The study area is the least socially and economically developed in Uganda.

In this study adaptation measures have been placed in two main categories: (a) physical adaptation measures that focus on tactic decisions made in response to seasonal variations in climatic variables and (b) institutional adaptation measures focus on strategic national decisions and policies on local to regional scales taking into account long term changes in climatic conditions over a long time. The adaptation/ mitigation needs and available technologies are presented in Annex IV.; while indicative costs of implementation are presented in Annex V and adaptation measures are elaborated in Appendix VI.

Physical adaptation measures in the agriculture production and development sector include: crop diversification, mixed crop-livestock farming systems, developing and promoting early maturing and drought-tolerant plant varieties & animal breeds, Small scale irrigation, among many others. In the water resources management and protection sector the main physical adaptation measures include: appropriate and sustainable water harvesting, storage, and utilization technologies; safe water supply and sanitation using appropriate technologies; provision of permanent water sources e.g. communal dams; promoting community best practices of collaborative water resources management, etc. In the ecosystem and environmental protection sector, the main physical adaptation measures are: tree planting; promoting community best practices of collaborative NR management; promoting production and marketing of SLM friendly products, etc., while in the health sector physical adaptation measures include: implementing clean drinking water and sanitation programs e.g. water boiling & hand washing; ensuring health systems are equipped to meet future demands; implementing surveillance systems for existing and new disease risks; studying and promoting herbal medicines for common ailments e.g. malaria, diarrhea, eye infections, coughs, etc.; studying and promoting traditional vector control methods e.g. cow dung smoke to repel mosquitoes. Some of the institutional adaptation measures are cross-cutting in nature e.g. concerted efforts from government, the donor community and funding agencies to assist farmers to implement adaptation programs; policy framework to guide & support effective adaptation by individuals and communities; high quality climate information and tools for risk management that help to improve climate predictions; integrating climate change issues into the sectoral planning and implementation

Adaptation needs and the practical measures for emergency and regular development programs in the study area are presented in Table 3.

**Table 3: Adaptation needs and practical measures for emergency and regular development programs in North Eastern Uganda (Karamoja)**  
**[adopted from Mubiru and Magunda, 2010]**

Sector	Adaptation/ mitigation need	Practical measure to meet need								
		Emergency program			Regular program			Adaptation criteria		
		Most urgent/ immediate	Urgent	Intermediate	Most urgent/ immediate	Urgent	Intermediate	E <sup>a</sup>	F <sup>b</sup>	State of use
<b>Agriculture production &amp; development</b>	<b>Physical adaptation measures</b>									
	Early maturing and drought- tolerant plant varieties & animal breeds	✓						✓	✓	In use but few ppl
	Mixed cropping/ Intercropping	✓						✓	✓	in use but few ppl
	Mixed crop- livestock farming systems				✓			✓	✓	Currently in use
	Crop diversification	✓						✓		In use but few ppl
	Adjusting planting & harvesting dates				✓			✓		Needs further improvement
	Soil & water conservation - general				✓			✓	✓	In use but few ppl
	Conservation agriculture				✓			✓	✓	In use by very few ppl & Needs further improvement
	Improving soil moisture retention				✓			✓	✓	In use by few ppl
	Small scale irrigation		✓					✓		Needs further improvement
Use of fertilizers and chemicals				✓			✓	✓	In use by few ppl	

Sector	Adaptation/ mitigation need	Practical measure to meet need								
		Emergency program			Regular program			Adaptation criteria		
		Most urgent/ immediate	Urgent	Intermediate	Most urgent/ immediate	Urgent	Intermediate	E <sup>a</sup>	F <sup>b</sup>	State of use
	Agro-forestry					✓		✓	✓	In use but few ppl
	Food preservation		✓					✓	✓	Need further improvement
	Fodder preservation	✓						✓		Need further improvement
	<b>Institutional adaptation measures</b>									
	Increased funding to promote CC adaptation				✓			✓	✓	Needs further improvement
	Policy framework				✓			✓	✓	Needs further improvement
<b>Water resources management &amp; protection</b>	<b>Physical adaptation measures</b>									
	Construction of dams to harvest runoff water				✓			✓	✓	In use by few ppl
	<b>Institutional adaptation measures</b>									
	Sensitization and advocacy					✓		✓	✓	Need further improvement
	Early warning systems					✓		✓	✓	Need further improvement
Collaborative water resources management					✓		✓	✓	Not in use	
<b>Ecosystem and environmental protection</b>	<b>Physical adaptation measures</b>									
	Tree planting						✓	✓	✓	In use but few ppl
	Collaborative NR management					✓		✓	✓	Need further improvement

Sector	Adaptation/ mitigation need	Practical measure to meet need									
		Emergency program			Regular program			Adaptation criteria			
		Most urgent/ immediate	Urgent	Intermediate	Most urgent/ immediate	Urgent	Intermediate	E <sup>a</sup>	F <sup>b</sup>	State of use	
	Production and marketing of SLM friendly products						✓	✓	✓	In use but few pple	
	<b>Institutional adaptation measures</b>										
	Sustainable use of under-utilized & non-conventional food stuffs						✓	✓	✓	In use by many pple	
<b>Health sector responses</b>	<b>Physical adaptation measures</b>										
	Kitchen gardening						✓	✓	✓	In use but few pple	
	Safe water supply and sanitation	✓							✓	✓	Needs further development
	Indigenous knowledge					✓			✓	✓	In use but few pple
	<b>Institutional adaptation measures</b>										
	Surveillance systems for existing and new disease risks	✓							✓	✓	Needs further development
	Health systems are equipped to meet future demands						✓		✓	Needs further development	

<sup>a</sup>E = Effectiveness

<sup>b</sup>F = Feasibility in terms of cost, social acceptance, and manageability

#### **4.4. Mainstreaming climatic change adaptation measures into policy frameworks, development planning and implementation**

Given the large threat posed by climate change to development, factoring climate change vulnerabilities into development strategies is an urgent task. There is need for increased integration of climate change adaptation measures into development strategies of government and donors, including livelihood strategies, food security programs, water resource development programs, and health and education programs and integrating climate change issues into all national, and sectoral planning processes .

The following are some of the identified development strategies where climate change adaptation measures could be mainstreamed: sector DSIPs (Development Strategy and Investment Plan), National Development Plan (NDP), District Development Plans (DDPs) and District Environment Action Plans (DEAPs), Sub-county Environment Action Plans (SEAPs, Poverty Reduction Development Plan (PRDP) and Karamoja Integrated Disarmament and Development Program (KIDDP). A good beginning has been made by mainstreaming Climate Change issues into the DSIPs of the Agriculture, and Water and Environment sectors and a Thematic Paper on Climate was used to mainstream climate change issues into the recently developed / on-going process of the development of the NDP.

Further to this, this Concept Note recommends:

- Adaptation strategies for climate change should be incorporated into all national policies and programmes related to food security and agriculture. Moreover, specific mechanisms must be put in place to ensure that such policies support communities' efforts to realize the right to food within the context of climate change and to ensure that the most vulnerable groups are not only able to benefit from such policies, but are involved in the development, implementation and monitoring and evaluation of the policies.
- Structural changes should be made in the design and implementation of adaptation programmes at country level to ensure adequate focus on food security and to increase the resilience of small-holder and urban farmers by enhancing their capacity to practice sustainable agriculture and by developing safety nets for climate risk management.
- Public spending on agriculture should be enhanced and oriented towards improving agricultural infrastructure, inputs, irrigation services and national agricultural extension services supporting small-holder farmers.
- The role of local authorities and civil society in developing, implementing and monitoring adaptation measures should be strengthened. Initiatives should be put in place to develop the capacities to engage in climate-related discussions at national level, to mobilise constituencies around climate change and food issues, and to involve them in the planning, implementation and monitoring of adaptation measures.

- Coordination and information exchange on climate change issues should be strengthened among policy making and implementing agencies as well as other stakeholders including the private sector, NGOs, researchers, and the media.

#### 4.5 Outreach Strategy

The communities in Karamoja still have strong well established social structures albeit changes due to the prevailing socio-economic and security situation. Key community/ traditional leaders are still well respected and their word carries a lot of weight. To successfully get to the community one needs the services of the key community leaders.

Due to insecurity many communities are organized in Manyattas to ensure security of person and property; this has made mobilization quite easy. Many activities are undertaken through community groups; however, there is still need to teach the members group dynamics, business skills, market exposure, technological issues, etc. Through the survey it was discovered that the community groups are mainly headed by men; this posed some challenges as men were reportedly not available sometimes and they also have a tendency of misusing the group financial resources.

For sustainability, it is best to access community groups through local leadership. For example the CMDRR projects have key community leaders as focal persons and there are also project sub committees as well as Disaster Risk Reduction sub committees at various levels, all designed to ensure project implementation and sustainability. Other approaches that ensure sustainability are using revolving funds or technology/ inputs rotation [source: **Hannah Longole, Program Officer CMDRR and John Bosco Nyanga, Program Assistant – Emergency and Disaster Risk Reduction**].

There is need to involve the communities/ groups right at the time of project planning/ inception to create a sense of ownership/ belonging. Where communities/ groups are not involved they tend to look at the intervention as a government or NGO project and none of their business. For example the Pokot in *Nabokotom* village, Amudat sub county, Amudat district have a cattle dip that was constructed by government but up to now they are still waiting for government to provide the chemicals to make the dip operation. According to the LC III Chairperson, if they had been involved probably they could have mobilized the necessary financial resources to purchase the chemical. It is through such scenarios that ZOA a Dutch NGO changed its approach. As a matter of policy, ZOA does not encourage handouts but instead community work is encouraged in exchange for farm inputs e.g. seeds, tools, etc [source: **Geoffrey Otim, Coordinator Agriculture and Livelihoods – ZOA and Ludy van Dijk, Program Manager – ZOA**].

It is paramount that community groups develop action plans and these should be developed in a participatory manner giving opportunities to community members to suggest the interventions/ technologies to be implemented.

The best information dissemination approach is straight talk i.e. direct interaction with the communities. Reportedly gatherings especially in church are the best forums for information dissemination. Other good communication methods are:

- Radio; this works well with well packaged information. However, the few radios in the sub region have small coverage. The best time for radio programs is during primetime (news hour) – 7:00am, lunchtime (1:00PM) and 8:00pm

- Cell phones; communication using cell phones is limited as some households do not have sets.
- Posters; this has a limitation in that many people in the sub region are illiterate therefore unable to read and write. However, well illustrated poster pictures have been found useful
- Documentaries

### The Dos and Don'ts

The following are some of the dos and don'ts while working with the communities to ensure successful implementation:

- Avoid fostering the “dependency syndrome”
- Avoid creating an image that you are more knowledgeable than the locals as this intimidates them
- Try as much as possible to work with local leaders and avoid undermining their authority
- Be open and truthful, i.e. do not hide information or lie.

### Challenges

- Due to language barriers between community workers and the local communities, there is a challenge of translating development messages
- Time – the more time spent with the local communities the greater the impact
- Limited financial resources
- The presence of soldiers brings activities to a standstill
- Non cost effective interventions e.g. the action of filling valley tanks using vehicles

## 4.6 Lessons learnt

### Box 7: Some of the lessons learnt and recommendations for intervention

Lesson learnt	Recommendations
Due to physical insecurity some communities have shifted from livestock to crop production contrary to practices by communities in other semi-arid areas	<ul style="list-style-type: none"> <li>• Improve the security of pastoralists and their assets</li> <li>• Increase service provision in crop production e.g. crop husbandry, irrigation, CA, etc.</li> </ul>
There are very few extension workers in Karamoja. The ratio of extension staff to the population is 1:5000 nationally, the ratio is even lower for Karamoja	Government should consider increasing the number of service providers in the sub region
Due to over extraction of groundwater with less rainfall and limited means of groundwater recharge the water table is further going down	<ul style="list-style-type: none"> <li>• Explore other water sources e.g. rainwater harvesting in ferro cement tanks, valley tanks and dams, etc.</li> <li>• Government should accelerate the groundwater mapping project</li> </ul>
The construction of physical soil and water conservation structures is expensive due to high	Work with researchers to identify live/ grass strips e.g. vetiver grass, kei apple, milk bush,

labor and material costs	etc.
Physical insecurity has necessitated fencing off <i>manyattas</i> which has led to cutting down of trees and overstocking	Encourage adoption of live fencing e.g. Kei apple, milk bush, etc.
The immediate need of the people in the sub region is food, therefore it is sometimes hard to get them involved in community projects where their immediate need is not addressed	Exploit the food for work approach to get the people involved in community activities
There are different levels of vulnerability among the Karimajong e.g. the youth, elderly, the disabled, disarmed warriors, etc.	Design strategies to reach the different vulnerable groups.
Due to a history of pastoralism, some adoption measures are used by a few people	Improve provision of extension/ advisory service
Forced settlement has not worked well for the people in the sub region	Revisit the migratory routes strategy and consider mobility as a strategy for pastoralism
Illiteracy rates are still very high, therefore there are several challenges regarding information dissemination	Continued use of radio programs and drama to disseminate information
The Karimojong just like rural communities in other parts of the country have several options for coping with climate change disasters/ challenges	Consider the coping strategies/ indigenous knowledge used by communities when planning interventions
Some coping strategies have been very detrimental to the environment e.g. charcoal burning, brick making, etc.	Promote environmental-friendly coping strategies, e.g. apiary, aloe vera, gum Arabic, etc.
Cereal banking is a novel idea that helps farmers from being exploited by traders	Promote the practice by giving out loans to enable farmer groups purchase cereals for banking

†Adopted from Mubiru et al. (2010)

## 5.0 CONCLUSIONS

Adverse impacts of climate change in Uganda and the study area in particular, include drought, famine, flash floods and flooding, prolonged dry spells and dust storms, among several others. Climate change impacts undermine health and well-being, the economy and overall development of the country. Food insecurity is a major challenge and climate change impacts are making food insecurity worse.

The average long-term annual rainfall for Uganda is about 1318 mm, which is adequate for agricultural activities. However, recent years have witnessed erratic onset and cessation of rainfall seasons and the rainfall seasons are interspersed with periods of no rain lasting from two to four weeks.

The uni-modal rainfall regime in northeastern Uganda commences from April to November with peak rainfall during April, May, July and August with laxity of rains during the month of June.

Significant increasing trend has been observed for the month of June while decreasing trends dominate the months of September, October and December. Although the observed increase in June monthly rainfall is beneficial as it is in the middle of the season, the observed decrease in rainfall at the end of the season is detrimental as it shortens the length of the potential crop growing period of the region posing challenges to pasture and crop growing.

Adaptation measures are important to help communities to better face the adverse impacts and associated effects of climate change. In this study adaptation measures have been placed in two main categories: (a) physical adaptation measures and (b) institutional adaptation measures. Physical adaptation measures focus on tactic decisions made in response to seasonal variations in climatic variables e.g. early maturing and drought-tolerant plant varieties and animal breeds and crop diversification in the agricultural sector; construction of dams to harvest runoff water in the water resources management and protection sector; safe water supply and sanitation and kitchen gardening in the health sector; and tree planting in the ecosystem and environmental protection sector. Institutional adaptation measures focus on strategic national decisions and policies on local to regional scales taking into account long term changes in climatic conditions over a long time e.g. increased funding to promote adaptation to climate change, early warning systems, collaborative natural resources management, surveillance systems for existing and new disease risks, etc.

Given the large threat posed by climate change to development, factoring climate change vulnerabilities into development strategies is an urgent task. There is need for increased integration of climate change adaptation measures into development strategies of government and donors, including livelihood strategies, food security programs, water resource development programs, and health and education programs and integrating climate change issues into all national, and sectoral planning processes e.g. sector DSIPs (Development Strategy and Investment Plan), National Development Plan (NDP), District Development Plans (DDPs) and District Environment Action Plans (DEAPs), Sub-county Environment Action Plans (SEAPs), Poverty Reduction Development Plan (PRDP), etc. A good beginning has been made by mainstreaming Climate Change issues into the DSIPs of the Agriculture, and Water and Environment sectors and a Thematic Paper on Climate was used to mainstream climate change issues into the recently developed/ on-going process of the development of the NDP

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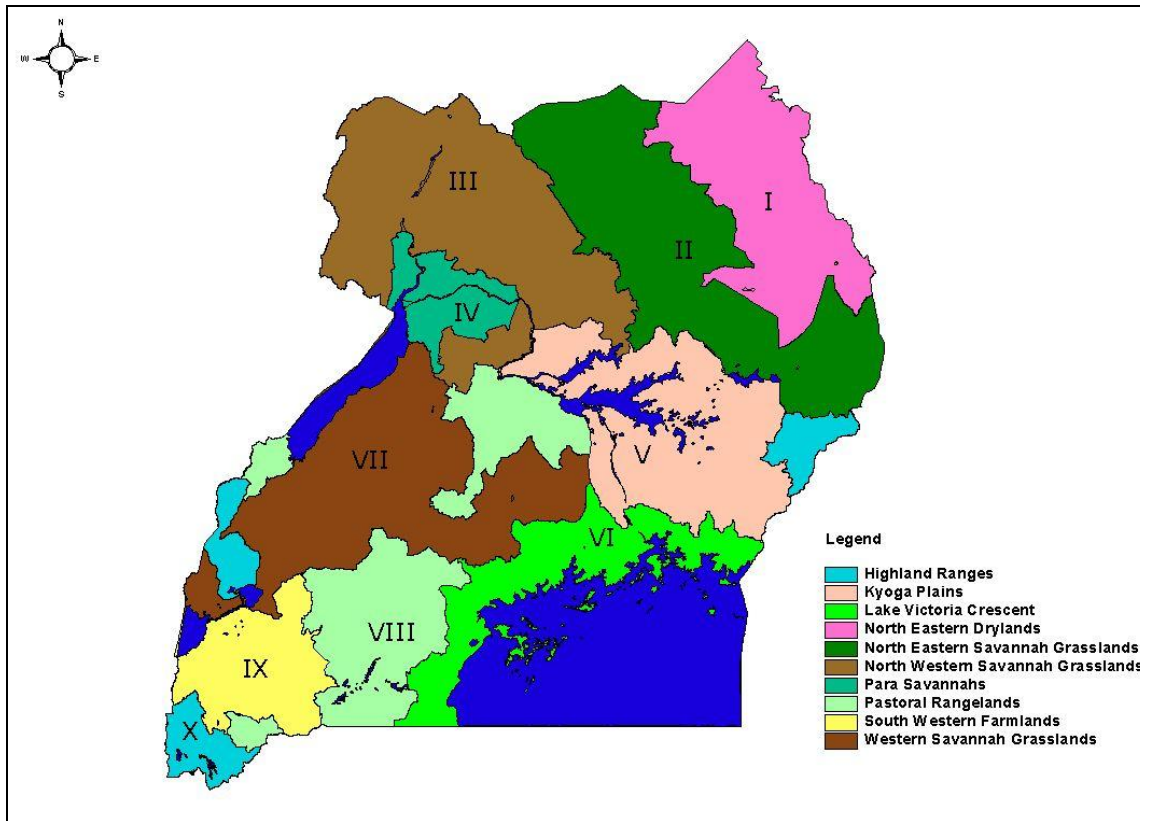
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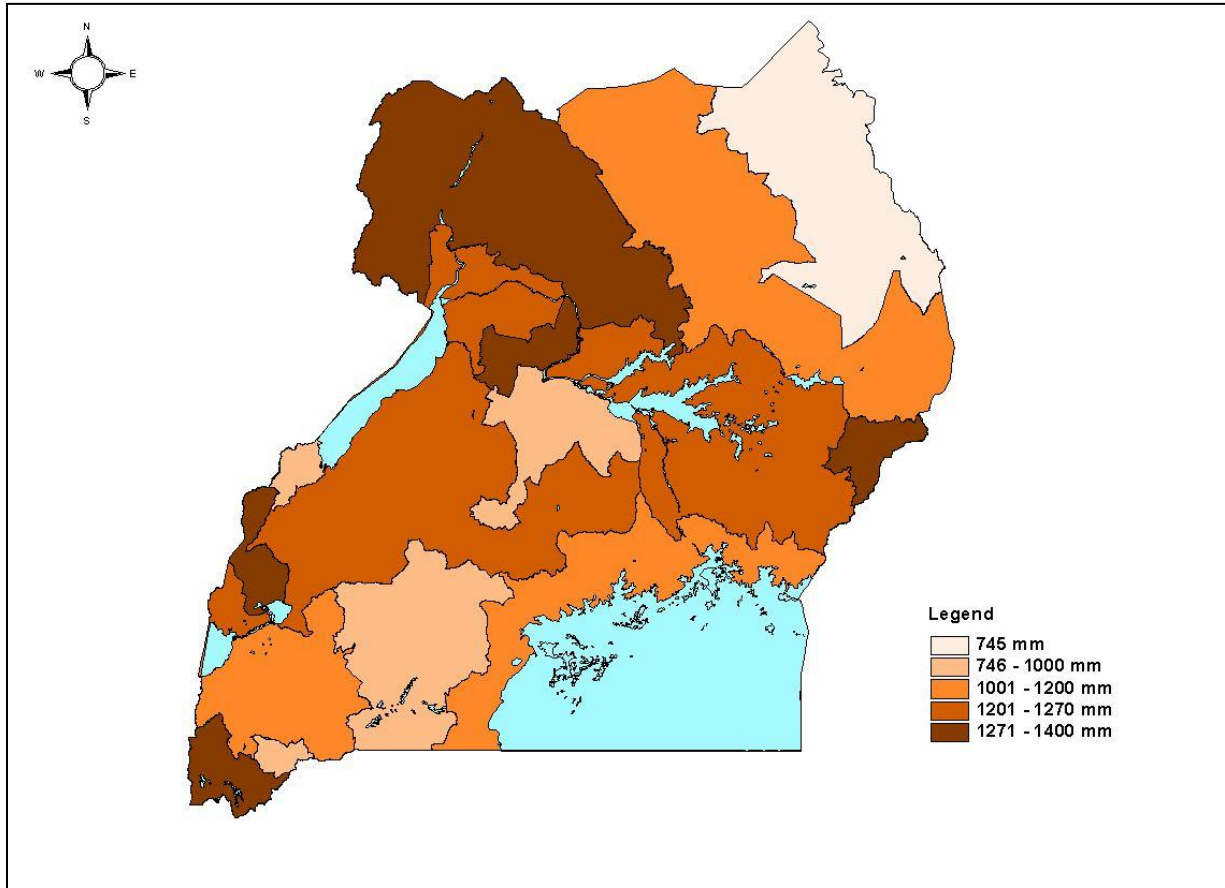
## 7.0 ANNEXES

- i. Broad agro-ecological zones of Uganda
- ii. Overall rainfall distribution in Uganda
- iii. The two broad agro-ecological zones that cover the study area
- iv. Adaptation /mitigation needs and the available technologies both in Uganda and the region for agriculture production and development
- v. Indicative costs and benefits of selected SLM practices
- vi. Elaboration of adaptation measures
- vii. People consulted

## Annex 1: Broad agro-ecological zones of Uganda



## Annex 2: Overall rainfall distribution in Uganda



### Annex 3: The two broad agro-ecological zones that cover the study area

Zone	Districts	Climate	Other characteristics
I	<ol style="list-style-type: none"> <li>1. Moroto</li> <li>2. Northern Kotido</li> <li>3. Eastern Kitgum</li> </ol>	<ul style="list-style-type: none"> <li>• Average rainfall of 745 mm with high variability, from about 600 mm over the north and northeastern parts to about 1000 mm over the southern and western parts.</li> <li>• One rainy season of about 5½ months, from April to early September with the main peak in July/August and a secondary peak in May. One long dry season of about 6 months from October to March. Most dry months from December to February.</li> <li>• Evaporation exceeds rainfall by a factor of over 10 during the driest months, December to February. During the rainy season evaporation is slightly more than rainfall.</li> <li>• Temperature ranges 12.5 – 32.5 °C</li> <li>• Altitude ranges from 351 – 1,524 m ASL</li> </ul>	<ul style="list-style-type: none"> <li>• Generally flat with isolated hills</li> <li>• Abundance of land still abundant in this zone</li> <li>• Shifting cultivation is practiced</li> <li>• Soils are moderate to poor</li> <li>• There is largely subsistence farming and pastoral activities</li> <li>• There are no natural open water bodies</li> <li>• Area is semi arid</li> <li>• Poor underdeveloped infrastructure</li> <li>• Ongoing programmes include NUSAF, KDA and WFP</li> <li>• Civil strife and cattle rustling</li> </ul>
II	<ol style="list-style-type: none"> <li>1. Pader</li> <li>2. Kitgum</li> <li>3. Eastern Lira</li> <li>4. Katakwi</li> <li>5. Northern Sironko</li> <li>6. Northern Kapchorwa</li> <li>7. Nakapiripirit</li> <li>8. Southern Kotido</li> </ol>	<ul style="list-style-type: none"> <li>• Average rainfall of 1197 mm with moderate variability, from about 1000 mm over the north and north-eastern parts to about 1300 mm over western and southern parts</li> <li>• One rainy season of about 7 months, from April to late October with the main peak in July/August and a secondary peak in May. One long dry season of about 4 months from mid-November to late March. Driest months are from December to February. Evaporation exceeds rainfall by a factor of over 10 during the driest months, December to February. During the rainy months, May; July and August rainfall is slightly more than evaporation</li> <li>• Temperature ranges from 15 - 32.5 °C</li> <li>• Altitude ranges from 975 – 1,524 m ASL</li> </ul>	<ul style="list-style-type: none"> <li>• Generally flat with isolated hills</li> <li>• Land is available but mainly in communal ownership</li> <li>• Shifting cultivation is practiced</li> <li>• Soils are moderate to poor</li> <li>• Wide wetlands with potential for irrigation</li> <li>• Farming is mainly communal and predominantly subsistence with emerging commercial farms</li> <li>• There is communal labour for cultivation</li> <li>• There is moderate to high literacy</li> <li>• Moderate infrastructure development</li> <li>• Area suffers from low incidental strife</li> <li>• Programmes include NUSAF, Olweny Rice Scheme, and VODP</li> </ul>

Source: GOU, 2004

### Annex 4: Adaptation/ mitigation needs and the available technologies both in Uganda and the region for agriculture production and development

Adaptation/ Mitigation Need	Available technologies/ variety/ type/ practices		Comments
Agriculture Production and Development			
Early maturing and drought tolerant crop varieties and livestock breeds	Sorghum	Sekedo	Improved high yielding sorghum variety but few people have adopted it. Sorghum seed is most time adulterated
		<i>Tinyitinyi</i>	Early maturing local varieties which are a bit sweet; they have been collected by NabZARDI for improvement and multiplication
		<i>Akirikir</i>	
		<i>Neterekuno</i>	
		<i>Tinyang</i>	
	<i>Ekabir</i>	Drought tolerant but late maturing	
	Legumes	Green grams	
		Cow peas	
		K131	Bean variety
		Tepari bean	Bean variety white in color
	Livestock	Zebu cattle	
		Goats	
		sheep	
		Camels	
Donkeys			
Turkeys			
chickens			
Ducks			
Mixed crop-livestock farming systems	Cows & sorghum		Agro-pastoralism
Mixed cropping	Maize & legumes		Mixed farming and crop rotations reduce the risk of complete crop failure as different crops mature at different times and are affected differently by climate events
Intercropping	Maize & legumes		Improves soil fertility, reduces soil and water loss and improves production/ yields of main crops
Crop diversification <sup>1</sup>	Cereals	Maize	Crop diversification can also serve as an insurance against rainfall variability
		Upland rice	
Adjusting planting & harvesting dates	Early/ dry planting, relay cropping		Any drop of water should no be left to go unutilized
Soil and water conservation – general		Live/ grass contour bunds/ ridges, stonelines, trashlines, contour cropping, diversion channels/ trenches,	These check the velocity of runoff, conserve in situ moisture, and increase groundwater recharge. However, there has been low focus on soil and water conservation due to inadequate technical capacity [KADP]

Adaptation/ Mitigation Need	Available technologies/ variety/ type/ practices		Comments
		terracing	Change in slope to reduce soil loss, runoff and increase rainfall infiltration and yield
Conservation agriculture		Minimum soil disturbance	Improves overall soil management, increased soil fertility and soil moisture, cost-effective and timely crop establishment. It also enhance carbon sequestration i.e. climate change mitigation
		Judicious crop rotations	
		Cover crops	
Agro forestry		Multipurpose trees -	Increased soil fertility, reduced erosion, long term benefits through productive tree species and short term benefits of intercropping. Meeting various socio-economic needs: provision of fuelwood and timber, boundary marking, ornamental function, fodder for animals, etc.. However, there are no private tree nursery operators in the two districts
Improving soil moisture retention		Mulching	
		Minimum soil disturbance	
Small scale irrigation			
Sustainable utilization of swamps			
Integrated nutrient management		Inorganic & organic fertilizers, BNF, Agro-forestry,	Higher productivity when combined on the plot; soil nutrient mining reduced; soil carbon conserved; climate risks reduced (better able to accommodate less predictable and more intense rains)
Post harvest handling	Drying	Maize & groundnut shellers, cassava & potatoes chippers	
	Preservation	Treatment with ash/ diatomaceous earth	
	Storage	Domestic-size silos/ granaries (50 l), large silos (30,000 l)	
	Crop value addition	Agro-processing	e.g. peanuts into peanut butter, cassava into flour or chips (targeting cooperative arrangements)
	Stocking of feeds (dry rations)	Hay-making	
<b>Water resources management and protection</b>			
Improving existing water sources	Desilting		There exists many water ponds, valley tanks, and dams that were constructed through community mobilization that have been silted
Protecting better water for domestic use and for general purpose	Training of water user committees		
Sustainable water sources	Sub surface water dams		

Adaptation/ Mitigation Need	Available technologies/ variety/ type/ practices		Comments
	Sand dams		
	Gravitational water flow systems		
	Water ponds/ pans		These would help conserve water by collecting surface runoff, borehole runoff which could be used for watering animals, tree nurseries and vegetable gardens
	Ferro cement tanks		Conservation measures to collect and retain runoff, easy to construct and materials readily available, also provides clean drinking water for homes, schools/ institutions
<b>Ecosystem and Environmental Protection</b>			
Increase forest cover	Woodlots/ Tree planting (afforestation/ reforestation)		Rehabilitation of degraded lands, long term benefits through productive tree species. However, there are no private tree nursery operators in the two districts
Reduce pressure on forests	Energy use for cooking and lighting	Energy saving stoves, efficient kilns for charcoal production	Mitigation measure to combat vegetation/ fuelwood depletion
Alternative livelihoods	Production and marketing of sustainable land management friendly products	Aloe vera, apiary, gum Arabic, shea nut butter	The sub region is endowed with many natural resources that only need sustainable exploitation to benefit the people while at the same time conserving the environment
	High value crops	Fruit trees and vegetables	
	Ostrich ranching		
Sustainable use of under-utilized and non-conventional food stuffs	Wild yams & fruits		

<sup>1</sup>Production success of different food crops is put at 30% rice, ≤ 50% maize and 80% sorghum

## Annex 5: Indicative costs and benefits of selected SLM practices<sup>4</sup>

Practice (top priorities only)	Establishment Costs (US \$)	Annual Maintenance costs	Benefit (economic, ecosystem, climate)
INM	\$ 400/ hectare	\$ 300/ ha	Short – term: Higher productivity when combined on the plot; soil nutrient mining reduced; yields increased; Climate change adaptation measure / risks reduced.  Long term - Soil carbon increased
Contour bunds	\$280/ km	\$ 50/ ha	Short term - Checks the velocity of run off, conserves in situ moisture, increases ground water recharge; yields / rangelands improved  Long term - Improves ecosystems services
Grass contours /bunds	\$120/ km	\$ 40/ ha	Short term - Checks the velocity of run off, conserves in situ moisture, increases ground water recharge; yields improved  Long term - Improves ecosystems services
Intercropping	\$90/ ha	\$ 45/ ha	Short term - Improves soil fertility, reduces soil and water loss and improves production/ yields of main crop; Climate change adaptation measure / risks reduced.  Long term - Soil carbon increased; ecosystem services improved
Mulching	\$ 250/ ha	\$ 100/ ha	Short –term : Checks and minimizes soil erosion mainly through reduced tillage practices and improved soil cover; Improves chemical and physical properties of the soil; Controls weeds; Climate change adaptation measure / risks reduced.  Long term - Soil carbon increased ; ecosystem services improved
Conservation Agriculture	\$ 300/ ha	\$ 200/ ha	Short –term: Checks and minimizes soil erosion mainly through reduced or no-tillage practices and improved soil cover; Improves chemical and physical properties of the soil; Controls weeds; Improves water infiltration rate and conserves soil moisture; Improves soil fertility; cost-effective and timely crop establishment. Climate change adaptation measure / practice  Long-term: Builds soil organic matter (SOM) content ; Improves ecosystems services
Agroforestry	\$ 200/ ha	\$ 100/ ha	Short term: Improves soil fertility, reduced erosion; improved yields and short term benefits of intercropping; Improved nutrition; improves incomes through sales/production of high value crops ; Climate change adaptation and mitigation measure / practice  Long term: Productive tree specie ; improved ecosystem

<sup>4</sup> Source of costs: Land Use Management – Lake Victoria Environment Management Project and Soils Database – NARO Kawanda and MAAIF – Directorate of Crop Resources

Practice (top priorities only)	Establishment Costs (US \$)	Annual Maintenance costs	Benefit (economic, ecosystem, climate)
			services
Woodlots	\$170/ ha	\$ 100/ ha	Short term: Reduced demand on available biomass; Reduced deforestation; REDD; Rehabilitation of degraded lands; wind break; Climate change mitigation measure  Long term: Improves ecosystem services; REDD; long term benefits through productive tree species
Terracing	\$700/ ha	\$ 250/ ha	Short – term: Change in slope to reduces soil loss, runoff and increase rainfall infiltration and yield; improves soil fertility  Long-term: Improves ecosystem services
Rehabilitation/ reclamation of degraded watersheds & sites	\$190 - 500/ ha (depending on state of site)	\$35-150/ ha	Short-term: Rehabilitation of degraded lands: gully rehabilitation by check dams, revegetation of bare hills, filling and revegetation of clay, sand, stone and murrum quarries/ mines  Health – reduced prevalence of malaria via reduced mosquito breeding sites (rehabilitated pits/excavation sites that serve as breeding grounds for mosquitoes)  Long –term: Improves ecosystem services
Shallow wells	\$3,000/ unit	\$ 400/ unit	Short –term: Conservation measure for livestock watering, also provides clean drinking water for schools/ institutions and domestic use  Health: reduced incidence of waterborne diseases (diarrhea; typhoid etc) through provision of clean drinking water
Household rain water harvesting /Ferro-cement tank	\$ 500/ unit (2,000 to 3,000 liters capacity)	\$ 100/ unit	Short-term: Conservation measure to collect and retain roof runoff, easy to construct and materials readily available, also provides clean water for domestic use  Health: reduced incidence of waterborne diseases (diarrhea; typhoid etc) through provision of clean drinking water
Institutional rain water harvesting /Ferro-cement tank	\$ 5,000/ unit (20,000 to 30,000 liters. Capacity)	\$ 200/ unit	Short-term: Conservation measure to collect and retain roof runoff, Easy to construct and Materials readily available, also provides clean drinking water for schools/ institutions  Health: reduced incidence of waterborne diseases (diarrhea; typhoid etc) through provision of clean drinking water
Run-off / Water harvesting from roads, paths etc	\$ 300 / ha	\$ 100 / ha	Short –term: Checks and minimizes soil erosion mainly through reduced overland water flow volume and velocity; Increases infiltration and underground water recharge; Increases yields; reduces moisture stress; Climate change adaptation measure/ risks reduced.  Long term - Ecosystem services improved

<b>Practice (top priorities only)</b>	<b>Establishment Costs (US \$)</b>	<b>Annual Maintenance costs</b>	<b>Benefit (economic, ecosystem, climate)</b>
Large surface runoff harvesting reservoirs	\$ 5,000/ unit	\$ 500/ unit	Short – term: Economical/ suitable where soils are highly permeable with significant water seepage losses; dam liners guarantee high water retention; small scale irrigation feasible  Health: reduced incidence of waterborne diseases (diarrhea; typhoid etc) through provision of clean drinking water
Household energy saving stoves	\$ 25/ unit	\$ 10/ unit	Short –term: Mitigation measure to combat vegetation/ fuel wood depletion  Long-term: Ecosystem services improved
Institutional energy saving stoves	\$ 400/ unit	\$ 50/ unit	Short – term: Mitigation measure to combat vegetation/fuel wood depletion  Long-term: Ecosystem services improved
Efficient kilns for charcoal production	\$ 2,000/ unit	\$ 500/ unit	Short – term: Mitigation measure to combat vegetation/fuel wood depletion  Long –term: Ecosystem services improved

## Annex 6: Adaptation to climate change – adaptation measures elaborated

1. **Early maturing and drought tolerant crop varieties** - Plant early and late maturing varieties of the same crop, sometimes putting the different seeds in the same hole
2. **Crop diversification** - In semi-arid regions, farmers should respond to decreases in food production by rethinking how they farm. Among the strategies used to reduce risk are water conservation and crop diversification
3. **Mixed cropping and crop varieties that are adapted to the local environment** - Farmers should combine local and traditional practices with innovations to reduce the risk of losing their harvest to natural hazards. They should practice mixed cropping and sow varieties that are adapted to their local environment to increase the chance that at least one crop will survive.
4. **Conservation agriculture** - SLM strategies help farmers to reduce soil erosion and retain more water in their farm fields and grazing lands. Retaining crop residues, minimizing tillage and using rotations and mixed cropping improve soil fertility and water infiltration
5. **Improving soil moisture retention** - improving soil moisture retention through mulching, and increasing the amount of organic matter in their soil.
6. **Soil Conservation – general** – coping strategy for soil erosion, landslides and soil degradation eg by
  - Construction of infiltration ditches around homes; digging trenches to divert runoff
  - Planting grass cover, mulching
  - Tree planting etc
7. **Food preservation** – a time-honored coping strategy practiced by many communities to ensure food security
  - Sun drying; use of herbal plants and ashes to store food
  - Use of honey to preserve meat and smoking
8. **Fodder preservation** – to offset shortages during the dry season
9. **Use of fertilizers and chemicals / Integrated Nutrient Management (INM)**
10. **Agroforestry** - Agroforestry is an SLM practice that incorporates trees and shrubs in croplands and pastures. These farm trees can moderate field temperatures, serve as wind-breaks and improve water infiltration. They also produce wood, fruits, fodder and medicines, which diversify food and income sources for crop and livestock producers. With climate-induced uncertainties, such diversified production systems enhance livelihood security and resilience.
11. **Construction of dams to harvest runoff water** - provision of water for domestic and livestock use ; small scale irrigation

12. **Formation of clubs** - In response to ever worsening harvests and increased food insecurity in their communities, rural women and the youth should be mobilized to form farmers clubs
13. **Pooling of resources, tools, seeds, and knowledge** – Farmers should pool resources, tools, seeds, and knowledge about agricultural practices so that they can respond collectively to decreases in food production
14. **Flood Control and Storm prevention committees** - Where floods, storms etc are recurrent phenomena, flood and storm prevention committees should be established from grassroots to sub-county / sub-catchment level. These committees should play a major role in disseminating information on flood prevention and educating communities on agricultural practices that reduce risks from natural hazards
15. **Alternative livelihoods or off-farm jobs** - The importance of non-farm jobs as a livelihood strategy to deal with failures of crop production and animal rearing. Women farmers should go into **petty trading and cottage industries that add value to harvested crops**. For example, peeling and drying cassava into dried cassava powder or process shea nuts into shea butter to sell at the local markets to supplement their normal crop production activities. Alternative livelihoods should be mainstreamed into community development
16. **Cottage industries and value addition** – making crafts; value addition etc
17. **Micro-credit and subsidies** - support to access micro-credit, small dams for dry season irrigation, subsidies for agricultural inputs and tractor services
18. **Increased funding to promote adaptation to Climate Change** - Farmers lack resources to adapt to climate change sufficiently. There is a need for concerted efforts from government, the donor community and funding agencies to assist the farmers to implement adaptation programmes.
19. **Policy framework** - Governments must play a key role in providing a policy framework to guide and support effective adaptation by individuals and communities. Some key recommendations of civil society include the need for:
  - High-quality climate information and tools for risk management that help to improve climate predictions. These will be critical, particularly for rainfall and storm patterns
  - Land-use planning and performance standards that encourage both private and public investment in buildings and other long-term infrastructure to take into account the vulnerability of different elements in the community systems.

- A financial safety net. This may be required for the poorest people who are often most vulnerable to the impacts of climate change and least able to afford protection.
20. **Water harvesting technologies** – with frequent droughts and water scarcity communities should harvest water from various sources eg rooftops; runoff, stems of trees
  21. **Sustainable exploitation of aquatic resources** – Communities adjacent to water bodies consider these resources as a common good. The intensification of the frequencies of droughts and famine compounds the exploitation of these resources.
    - Fishing activities intensify as an alternative livelihood (Soroti and Lira )
    - Consumption of aquatic plants eg water lily (corms) etc
  22. **Collaborative water resources management** – mobilizing communities to plant degraded land with exotic and native trees that produce livestock fodder, firewood, timber etc while re-vegetating critical watershed areas to safeguard hydrological functions and soil fertility.
  23. **Sustainable use of under-utilized & non-conventional foodstuffs** –Available in the traditional farming systems and in the wild. Eg wild yams and wild fruits. In times of food scarcity these could be sustainably harvested.
  24. **Safe water supply and sanitation** - Implement drinking water and sanitation programmes in areas at risk from climate change (e.g. lake shore / Kyoga areas and areas prone to floods and drought); drilling of bore holes and wells
  25. **Promotion of hygiene and sanitation strategies** – intensify hygiene and sanitation during flood periods to include water boiling, hand washing and awareness campaigns
  26. **Kitchen gardening** - Kitchen gardening by women also makes a contribution to household nutrition. It increases their resilience as well, since vegetable surpluses can be sold to provide extra income to the family and seeds can be dried.
  27. **Indigenous Knowledge – Under utilized and not properly documented**
    - **The knowledge of elderly people** also allows communities to cope with adverse conditions. Traditional medicine has been passed on by ancestors on how to treat their animals and prevent diseases. Livestock is an insurance against crop failure and a way to diversify livelihood. In bad years animals are sold to buy food
    - **Herbal medicine** –to treat malaria, diarrhea, wounds, worms, skin diseases, eye infections and coughs
    - **Traditional vector control** – In times of increased mosquito population especially during floods, communities use cow dung smoke to keep away mosquitoes from homesteads
  28. **Surveillance systems for existing and new disease risks** - Implement surveillance systems for existing and new disease risks and ensure health systems

29. **Disaster management committee** – establishment of standing or rapid response committees to deal with disaster
30. **Renting land** – Where floods displace people (e.g. Lira) land for agriculture is rented through a batter system using the produce and/or livestock.

## Annex 7: People Consulted

Name	Organization	Designation	Date
Patrick Nyeko	Samaritan's Purse		14/07/10
Dr. Edward Okori	FAO – Moroto office	Head of Office	14/07/10
Dr. Paul Opio	FAO – Moroto office	Coordinator Livestock and livelihoods Program	14/07/10
Abura, Stephen	KADP	Governance & Conflict Transformation	15/07/10
Longole, Hannah	CMDRR	Program Officer	15/07/10
Nyanga, John Bosco	CMDRR	Program Assistant	15/07/10
Odong, Achila	Moroto district	District Production Officer	15/07/10
Angera, Zackary	Moroto district	District Forestry Officer	16/07/10
Lotyango, John	Moroto district	Environmental Officer	16/07/10
Otuta, Rogers	ACTED	Program Assistant, Drought Early Warning System	16/07/10
Otim, Geoffrey	ZOA	Coordinator, Agriculture and Livelihoods	17/07/10
Van Dijk, Ludy	ZOA	Program Manager	17/07/10
Lomongin, Emmanuel	Kaabong district	District Environmental Officer	19/07/10
Angálla, Ernest	OXFAM (Kotido office)	Program Officer, Food Security & Livelihoods	20/07/10
Akech, Tosquine Harriet	ADRA - Kotido	Livelihoods & Food Security Officer	20/07/10