THE INFLUENCE OF CLIMATE CHANGE ON FOOD SECURITY IN UGANDA: CASE STUDY OF LWAMAGGWA SUB COUNTY, RAKAI DISTRICT

BY

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A RESEARCH REPORT SUBMITTED TO THE COLLEGE OF SOCIAL SCIENCES AND HUMANITIES IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF A BACHELORS DEGREE IN DEVELOPMENT STUDIES OF KAMPALA INTERNATIONAL UNIVERSITY

JAN, 2015

DECLARATION

I NABUKENYA VICTORIA declare that to the best of my understanding this is my own work and has never been submitted to any institution for any academic award. Work obtained from other sources, authors have been acknowledged.

Signature.....

Date.....14th/12/2014.....

APPROVAL

This work has been under my supervision and is now ready for submission with my approval as a university supervisor

Mr. SSEKATE JOHNMARY

Supervisor

Signature.....

Date....14th/12/2014.....

DEDICATION

This research report is dedicated to my guardians Mr. and Mrs. Yiga Benon and Nagadya Mary, my sister Yiga Hariet, my grandmother Yiga Cate for their commitment to my education up to this level.

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I wish to express my gratitude to all people whose support has encouraged me to complete this research successfully. These include; My friends Namutosi Evalyne, Namukoma Jackie, Ssekitoleko Joseph, my supervisor David Asiimwe, Dr. Tindyebwa Wilberforce, brother Mike, sister Ester, sister Agie, brother dan, aunt Margret, sister Suzan aunt mary, aunt Milly, aunt Dorah, uncle Fred, uncle Jimmy brother Charles.

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LIST OF ABBREVIATIONS

CO2:	Carbon dioxide
ECU:	Environmental Change Unit
EPA:	Environmental Protection Agency
EPIC:	Erosion Productivity Impact Calculator
GDP:	Gross Domestic Product
GISS:	Goddard Institute of Space Studies
IIASA:	International Institute for Applied Systems Analysis
IPCC:	Intergovernmental Panel on Climate Change
MINK:	Missouri-Iowa-Nebraska-Kansas
USAID:	United States Agency for International Development

ABSTRACT

The study focused on the Impact of climate change on food security in central Uganda, a case study of Lwamagwa sub-county in Rakai district. Issues of climate change depends on various factors but this study specifically focused; on indicators of climate change in Lwamaggwa sub county; assess how climate change affect food security in Lwamaggwa Sub County; to examine the challenges of climate change in Lwamaggwa Sub County and to identify possible measures that can be taken to improve on food security in Lwamaggwa Sub County. The study used both descriptive and exploratory research designs to explore and describe the implications of climate change on food security in the study area.

The findings noted that change in climate effects into decline in farm/crop produce hence making lives of people who depend on crops for their survival very complicated. It was further established that food security in Lwamagwa will continue to decline if appropriate measures to climate change are to adopted, this is because the effects of climate change are largely due to human activities that included the encroachment of the human population onto the fragile ecological; systems that help in the modification of climate like wetlands and forests. Different measures were being used to ensure that crop farmers avoided total loss in case of adverse climate change effects came. However, they had to be used interdependently as one measure would no fully solve the effects of climate change on the overall socio-economic livelihoods of crop farmers in Lwamaggwa Sub County. This study therefore recommend that coming up with structured policies on environmental protection in Rakai district and development of control of poor farming methods will improve food security in the area and enhance economic growth and development through increased food production.

CHAPTER ONE

INTRODUCTION

1.0 Introduction

This chapter presents the introduction and background of the study. The chapter further explains the statement of the problem, objectives of the study, research questions, scope and significance of the study. The study is specifically looking at how climate change is affecting food security in Uganda.

1.1 Background to the study

Food production and security is one of the society's key sensitivities to climate. A year of not enough or too much rainfall, a hot spell or cold snap at the wrong time, or extremes, like flooding and storms, can have a significant effect on local crop yields and livestock production. While modern farming technologies and techniques have helped to reduce this vulnerability and boost production, the impact of recent droughts in the USA, China and Russia on global cereal production highlight a glaring potential future vulnerability.

Food Security is highly sensitive to climate variability and weather extremes, such as droughts, floods and severe storms. The forces that shape our climate are also critical to farm productivity. Human activity has already changed atmospheric characteristics such as temperature, rainfall, levels of carbon dioxide (CO2) and ground level ozone. The scientific community expects such trends to continue. While food production may benefit from a warmer climate, the increased potential for droughts, floods and heat waves will pose challenges for farmers. Additionally, the enduring changes in climate, water supply and soil moisture could make it less feasible to continue food security in certain

regions. The Intergovernmental Panel on Climate Change (IPCC, 2007) concluded:

Recent studies indicate that increased frequency of heat stress, droughts and floods negatively affect crop yields and livestock beyond the impacts of mean climate change, creating the possibility for surprises, with impacts that are larger, and occurring earlier, than predicted using changes in mean variables alone. This is especially the case for subsistence sectors at low latitudes. Climate variability and change also modify the risks of fires, pest and pathogen outbreak, negatively affecting food, fiber and forestry.

It seems obvious that any significant change in climate on a global scale should impact local agriculture, and therefore affect the world's food supply. Considerable study has gone into questions of just how farming might be affected in different regions, and by how much; and whether the net result may be harmful or beneficial, and to whom. Several uncertainties limit the accuracy of current projections.

One relates to the degree of temperature increase and its geographic distribution. Another pertains to the concomitant changes likely to occur in the precipitation patterns that determine the water supply to crops, and to the evaporative demand imposed on crops by the warmer climate. There is a further uncertainty regarding the physiological response of crops to enriched carbon dioxide in the atmosphere. The problem of predicting the future course of agriculture in a changing world is compounded by the fundamental complexity of natural agricultural systems, and of the socioeconomic systems governing world food supply and demand.

What happens to the agricultural economy in a given region, or country, will depend on the interplay of the set of dynamic factors

specific to each area. Scientific studies, typically based on computer models, have for some time examined the effects of postulated climate and atmospheric carbon dioxide changes on specific agro ecosystems--a now common term that defines the interactive unit made up of a crop community, such as a field of wheat or corn, and its biophysical environment. We have more recently gone a step farther by developing methods to study these systems in more integrated regional and global contexts. Both biophysical and socioeconomic processes are taken into account in these integrated studies, since agricultural production is a player in both worlds: it is very much dependent upon environmental variables and is in turn an important agent of environmental change and a determinant of market prices. Climate change presents food security with prospects for both benefits and drawbacks. To address any of them more clearly we must first define the main interactions that link a chain of processes together: food is derived from crops (or from animals that consume crops); crops in turn grow in fields, which exist in farms, which are components of farming communities, which are sectors in nation states, and which ultimately take part in the international food trade system. Understanding the potential impacts of global environmental change on this sequence of interlocking elements is a first step in modeling what will happen when any one of them is changed as a result of possible global warming, and a prerequisite for defining appropriate societal responses.

1.2 Statement of the problem

The future course of global food production will depend on how well societies can adapt to climatic changes, as well as the influence of other pressures, such as the competition for land from biofuel production. The World Food Program (2013) reported that in the poorer, low-latitude countries like Uganda climate change could seriously challenge the capacity to adapt for a warming of more than 3°C. While modern

farming technologies and techniques have helped to reduce the vulnerability of food production to climate change, and to boost production, the impact of recent droughts in Uganda, Karamoja, Masaka and Kanungu on food production highlight a glaring potential future famine and poverty. Food security is one of the sectors that promote the livelihoods of people in Kanungu and western Uganda as a whole. It provides food for the families, income from surplus food sales and security in case they want micro finance loans for investment in families. Crops contribute to the national incomes and GDP through exports and this makes it easier for the government to provide social services to the population. This can be achieved if there is good climate to sustain the proper growth of these crops so that they can produce good harvests. Good climate involves good rainfall and relative sunshine that favor crop growth.

However, with the current trend of changes in climate change as a result of pollution and global warming temperatures have increased tremendous and rainfall has reduced to very abnormal amounts and this has led to poor food security which has made the dependants on the sector face the challenge of famine and crop losses. This has made people vulnerable to poverty and underdevelopment hence forth this study will aim at ensuring that it explores and describes how climate change affects food security in central Uganda specifically in Lwamaggwa sub county, Rakai district.

1.3 Purpose of the study

The study intended to assess the influence of climate change and its implications on food security in central Uganda particularly Lwamaggwa sub county.

1.3.2 Specific objectives

i. To identify the indicators of climate change in Lwamaggwa sub county
ii. To assess how climate change affect food security in Lwamaggwa Sub County.
iii. To examine the challenges of climate change in Lwamaggwa Sub County.
iv. To identify possible measures that can be taken to improve on food security in Lwamaggwa Sub County.

1.4 Research questions

i. What are the indicators of climate change on food security in Lwamaggwa Sub County?
ii. How has climatic changes affected food security in Lwamaggwa Sub County?
iii. What are the challenges of climate change in Lwamaggwa Sub County?
iv. What are the possible solutions to improve on food security in Lwamaggwa Sub County?

1.5 Scope of the study

1.5.1 Content scope

The study was conceptually focused on the causes of climate change, the effects of climate change on food security in Lwamaggwa Sub County, the remedies to climate change problem and the measures that can be taken to improve food security for household Food Security in western Uganda. This compounded it all in assessing how climate change implicated on food security in western Uganda specifically Lwamaggwa sub county.

1.5.2 Geographic scope

This study was carried out in Rakai district in Lwamaggwa Sub-county given that subsistence agriculture is the dominant economic activity in the district growing specifically Matooke, beans, cassava and potatoes for food production and livestock keeping like cattle, goats, pigs and chicken. Rakai borders Lyantonde to the northwest and Lwengo district to the north, Masaka district to north east and Kalangala to the east. The study will be conducted in the villages of Kibuuka, kyanika and lwensambya in Lwamagwa sub-county.

1.5.3 Time Scope

The study was conducted within a period of four months starting from October 2014 to January 2015 considering a time period of 2 years since 2013 as this is when Rakai was reported to have been mostly affected and animals and crops were destroyed due to hostile climate conditions.

1.6 Significance of the study

The study results will help farmers to understand what they can do or put in place to control the causes of climate change as farming is one of the most serious economic activity affected by climate change. Hence the results will educate the farmers on how they can practice environmentally sustainable agriculture without affecting and being affected climatic factors for better production.

The study findings will help environmentalists to find the appropriate means that can be adopted to solve the causes of climate change. This will to minimize on the climate change variations that would put farmers at a risk of food insecurity.

The study findings will help the farmers to plan well for their farming activities so that they can not be severely affected by climate change hence ensuring a sustainable livelihood. This will help farmers to avoid losses a result of failure to predict the seasons for climate changes.

The study findings will help the government to plan for the dangers that may come from climate change which may put the socio-economic livelihoods of people at stake.

The study results will help future scholars as a source of future reference in case they want to study a related or similar problem at length.

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CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter presents the works of previous researcher which is related to the themes of this research including climate change and its impact on food security, socio economic development and the

2.1 Trends of Climate change

Climate change impacts many different aspects of the socio-ecological system including disease coverage, biodiversity, land degradation and changes in water availability. These changes have significant implications for social systems, although the way in which change is actually experienced depends on location, exposure, sensitivity and the ability of a society to respond. The implications of climate change and extreme weather events for urban areas, in particular, are not well understood, as much of the existing research focuses on rural areas. The characteristics of urban settlements determine the nature of the climate impacts and, in some instances, the nature of climate events.36 The concentration of population, economic activity and built environments in urban areas can change exposure to floods, heat waves, and other climate and weather events. For example, heavy precipitation might fall equally over neighbouring urban and rural areas. However, hard surfaces within the urban landscape could lead to increased run-off and flooding not experienced in the rural areas. Similarly, the impact of a general increase in temperature can differ between neighbouring urban and rural areas. The heat generated by the city (known as the urban heat island effect) further increases air temperatures.

Climate change is expected to aggravate such phenomena, although the severity of the impact will depend on the adequacy of planning and governance. Some climate projections are therefore appropriate to both urban and rural areas in a region, while others need to consider the feedback impacts of the urban landscape.

Much of the existing research on the implications of climate change for urban areas focuses on broader processes such as changes in precipitation, temperature, extreme events and sea level rise. There is also scientific research emerging that looks more closely at urban climate change dynamics including how aerosols can change the nature of urban precipitation and how temperature inversions might shift with changing synoptic states. Such detailed climate science has not been well integrated into work on urban social impacts and human adaptation and information is limited on how climate change impacts are likely to be experienced at the urban scale. The London Climate Change Partnership was one of the earliest groups to recognise this gap and conducted a study detailing the key climate change impacts on different urban issues such as water resources, health, biodiversity, transport and business and finance.

There is overwhelming evidence that the global climate is changing, observed directly through increasing average air and ocean temperatures, changes in the frequency and severity of storms, alterations in precipitation patterns, and extreme weather events. There has been an increase in the frequency of storms, with heavy precipitation over most land areas. Long-term trends (between 1900 and 2005) show significantly increased precipitation in the eastern parts of North and South America, northern Europe, and northern and central Asia. Parts of the African Sahel, the Mediterranean, Southern Africa, and Southern Asia have become drier.

Since the 1970s, droughts have become longer and more intense, affecting larger areas, especially in the tropics and subtropics. In Southern Africa there has been a warming trend consistent with global temperature increases. This has been accompanied by a greater frequency in below normal rainfall years, with a high number of drought events being reported in the last few decades. Significant food shortages are associated with these droughts. In the drought of 2002-3, for example, there was a regional food deficit of 3.3 million tonnes and 14.4 million people needed emergency assistance

Since the late 1950s, global agricultural output has increased at rates and to levels that are unprecedented in human history. Much of the productivity increase is attributed to the breeding of high-yielding crop varieties, intensive use of inorganic fertilizers and pesticides, expansion of irrigation, and capital-intensive farm management.

In the 1970s, the euphoria surrounding the 'Green Revolution' was questioned in the wake of the energy crisis and growing awareness of long-term environmental consequences. Concern over soil erosion, groundwater contamination, soil compaction and decline of natural soil fertility, and destruction of traditional social systems, led to a reappraisal of what were then considered to be the most advanced agricultural production techniques. Since then, agricultural research has expanded its scope to include sustainable and resource-efficient cropping systems and farm management practices.

In Uganda, about a third of the population lives in extreme poverty. Most households depend on rain-fed agriculture as their main source of income, with the agricultural sector employing over three-quarters of the labor force (83% of women and 71% of men) but only accounting for 24% of gross domestic product (MFPED, 2010). Women contribute 70%

to 75% of agricultural food production. A survey conducted by UNWFP (2009), reported that 6.3% households in Uganda were food insecure and 21.3% households were at risk of becoming food insecure. Recently the average food production is relatively low as required by the World Health Organisation. This study is aimed at assessing the contribution of women participation in commercial agriculture towards food security in Uganda. This chapter presents the background, problem statement, research objectives, scope and significance of the study.

Women make essential contributions to the agricultural and rural economies in all developing countries. Their roles vary considerably between and within regions and are changing rapidly in many parts of the world, where economic and social forces are transforming the agricultural sector. Rural women often manage complex households and pursue multiple livelihood strategies. Their activities typically include producing agricultural crops, tending animals, processing and preparing food, working for wages in agricultural or other rural enterprises, collecting fuel and water, engaging in trade and marketing, caring for family members and maintaining their homes. Many of these activities are not defined as "economically active employment" in national accounts but they are essential to the well-being of rural households.

Commercial" agriculture as being "production primarily for market and it is not dependent on scale of production or related to particular types of crops. Different farm systems can engage in commercial agriculture including family farms" (i.e. smallholders), characterized by the predominant use of family labour, no permanent workers and, at the most, only seasonal labor hired for peak production times; "small investor farmers", where the owner and perhaps other family members

are involved primarily in management and supervisory capacities, whilst the bulk of the labour input is provided by hired farm workers (typically including several permanent, full-time employees) and "large-scale commercial farms", where family labour is exclusively or predominantly managerial, there is a permanent staff of full-time hired farm workers and these hired farm staff are to some degree specialized (e.g. drivers).

The events of the past few years have highlighted the vulnerability of global food security to major shocks – both in the global agricultural markets and in the world economy. The food price crisis and the ensuing economic crisis reduced the purchasing power of large segments of the population in many developing countries, severely curtailing their access to food and thus undermining their food security. The rise in global undernourishment numbers in 2008 was a result of the spike in food prices from 2007 to 2008. From a historical perspective, the price developments in this period are not unprecedented, with markets exhibiting a comparable spike during the "world food crisis" of 1973–75, Even so, FAO's Food Price Index(FPI) declined in real terms (using the United States GDP deflator) over the period 1961– 2010. Since the early 2000s, however, the downward trend appears to have been reversed, or at least interrupted, with food prices increasing significantly in real terms, culminating in the price spike of 2007–08. Although international food commodity prices fell in 2009, they remained high relative to prior years, and data through to October 2010 indicate an increase in the FPI from 2009 to 2010. Moreover, high domestic prices have persisted in many countries, as the decline in international prices was slow in being transmitted to domestic markets.

While food prices remained above their pre-crisis level, reduced incomes caused by the financial crisis had a detrimental effect on access to food, leading to a further sharp increase in global undernourishment levels. According to estimates of growth in per capita GDP (approximated using International Monetary Fund [IMF] estimates of growth in total GDP minus population growth rates), the global GDP per capita contracted in 2009, with the advanced economies affected more than the economies of the developing world. However, per capita GDP declined or stagnated in all developing regions, with the exception of developing Asia – where per capita GDP growth slowed to 5.8 percent, compared with more than 10 percent in 2007 (IMF, 2010a; IMF, 2010b).

2.2 Food production and the economic sector

The economic recession had a severe negative impact on export revenues, foreign direct investments and foreign migrant remittances received by developing countries (FAO, 2009b). By 2010, the burgeoning recovery of the world economy and the significant increases in economic growth rates underpinned the reduction in global undernourishment numbers discussed above. In spite of the declining numbers in 2010, reflecting the resumption of economic growth and reduction in food prices, the two crises have drawn our attention to the acute vulnerability of poor countries and populations to global shocks such as those experienced in the most recent years. In addition, localized shocks and emergencies have affected food security in specific countries as well as at the sub national. Mechanisms to protect the most vulnerable populations from the effects of such shocks are often woefully inadequate. Consequently, vulnerable households may be forced to deal with shocks by selling productive assets, which are very difficult to rebuild, thus extending and prolonging the negative impacts of the crisis far beyond its immediate effect.

Since the beginning of the 1980s yet another threat to agriculture has attracted much attention. Many climatologists predict significant global warming in the coming decades due to increasing atmospheric carbon dioxide and other trace gases. As a consequence, major changes in hydrological regimes have also been forecast to occur. The magnitude and geographical distribution of such climate-induced changes may affect our ability to expand food production as required to feed a population of more than 10 000 million people projected for the middle of the next century. Climate change could have far-reaching effects on patterns of trade among nations, development, and Food Security.

Beyond what is known about greenhouse gases and the climate system, however, lie great uncertainties: How much warming will occur, at what rate, and according to what geographical and seasonal pattern? What secondary processes will the warming trend induce, and what might be the physical and biological impacts of such processes? Will some areas benefit while other areas suffer, and who might the winners and losers be? And, if such damages are unavoidable, what can be done to adapt or modify our systems so as to minimize or overcome them? These are important and complex questions, and we have only begun to understand them and to develop methods for their analysis.

Recent research has focused on regional and national assessments of the potential effects of climate change on agriculture. For the most part this work has treated each region or nation in isolation, without relation to changes in production elsewhere and without paying attention to climate change effects on the world market and their feedbacks. Assessments of potential impacts have been achieved in national studies completed in the United States (Adams *et al.,* 1990, 1994; Smith and Tirpak, 1989), Australia (Pearman, 1988), and the United Kingdom (UK Department of the Environment, 1991). Regional

studies have been conducted in high-latitude and semi-arid agricultural areas (Parry *et al.,* 1988). These regional and national studies have been summarized in the IPCC Working Group II Reports (IPCC, 1990b, 1996.

In 1989 the US Environmental Protection Agency (EPA), with additional support provided by the US Agency for International Development (USAID), commissioned a three-year study on the effects of climate change on world food supply. The present study is an initial attempt to arrive at an integrated global assessment of the potential effects of climate change on agriculture and the world food system. The collaborative project was jointly managed by the Goddard Institute of Space Studies (GISS) and the Environmental Change Unit (ECU) in collaboration with the International Institute for Applied Systems Analysis (IIASA) and involved about 50 scientists worldwide.

2.3 Food security in Uganda

Over the last three decades, the world has witnessed rapid changes in global policy environment ranging from protectionist planned economic systems to liberalised and externally driven market-led economic systems. Many developing countries, including Uganda, experienced sweeping economic crises in the late 1980s and 1990s, and as a result a number of them were forced to undertake economic policy reforms, largely supported by the World Bank and the International Monetary Fund (IMF) (MAAIF, 2009). In agriculture, economic policy shifts included the lifting of price fixing by state organs, the dismantling of monopolistic state produce and marketing boards, downsizing of government extension staff and total elimination of government provision of agricultural subsidies and/or free provision of fertiliser, seed and other agricultural inputs.

The implementation of adjustment programmes in Uganda had multiple impacts that affected various sectors of the Ugandan economy. The agricultural sector was drastically affected due to its interdependence on other sectors such as industry, the transport and communication sector, investment, public service and trade, among others. One of the major changes associated with adjustment was the introduction of the policy of decentralisation. The implementation of the decentralisation administrative system was aimed at easing the policy making process and enhancing the bottom up approach which increases stakeholder participation. However, the process of decentralisation was not followed up by adequate resource allocation and capacity support. As a result, decentralised government agencies have limited resources and this is negatively affecting their performance.

Ziegler (2002 cited in Chilton and Rose 2009) explains the 'rights based' approach to food security, claiming that food security is 'the right to have regular, permanent and unrestricted access, either directly or by means of financial purchases to quantitatively and qualitatively adequate and sufficient food corresponding to the cultural traditions of the people to which the consumer belongs'. Food security is considered in this article in terms of access to food at individual and household level. This article argues that the barriers to successful food security projects are rooted in social systems that systematically disadvantage some sections of the community in accessing food.

The logic and rationale of this current approach fits well with the Ugandan government's 'Plan for Modernisation of Agriculture', established in 2000. The objectives of that plan were to 'increase incomes and improve the quality of life of poor subsistence farmers, improve household food security, provide gainful employment'. The mission was 'eradicating poverty by transforming subsistence

agriculture to commercial agriculture' (MAAIF 2000). The intention was that farmers would orient most of their production to the market to gain higher incomes. By doing this, they could guarantee food security. Instead of providing their own food through their farms, they would specialise in profitable commercial crops and use the income to purchase food. Technological change that would increase productivity for these farmers would also 'keep downward pressure on real food prices'. In other words, farmers would use technology to produce more with less land and labour, causing a drop in food prices. This drop in food prices was expected to benefit both rural and urban poor, in their role as food purchasers. An expansion of the food market coming from lower prices and increased production was also expected to provide capital for business ventures in the urban areas. Increased income for farm households would also stimulate economic activity in rural areas.

Ultimately, people would 'leave agriculture' as the stimulus from lower food prices enabled industrial growth in the towns. Land markets were to be enabled by land reforms to secure property rights. The effect would be that small farmers who left rural areas to get work in the cities could sell their land to more efficient large scale enterprises (MAAIF 2000).

According to World Food Program (WFP, 2012), Between 1995 and 2010, left hundreds of thousands of Somalis country in search of food, shelter and security, most going to neighbouring Kenya, where they lived in Dadaab, the largest refugee camp in the world. Others made their way to Ethiopia and other countries in the region. Somalis remaining in the country experienced internal displacement and eroded traditional coping skills and strategies by many years of conflict. Over the years, the United Nations has a number of initiatives in an attempt

to address the causes of instability in Somalia, but as of late 2011, this had yet to restore security to the country.

Agriculture is underperforming in many developing countries for a number of reasons. Among these is the fact that women lack the resources and opportunities they need to make the most productive use of their time. Women are farmers, workers and entrepreneurs, but almost everywhere they face more severe constraints than men in accessing productive resources, markets and services. This "gender gap" hinders their productivity and reduces their contributions to the agriculture sector and to the achievement of broader economic and social development goals. Closing the gender gap in agriculture would produce significant gains for society by increasing agricultural productivity, reducing poverty and hunger and promoting economic growth.

2.4 Impact of Climate Change on Crop Production

Crop yield analysis, spatial analysis, and agricultural systems analysis are the three main approaches for studying the "Implications of a Global Climatic Warming for Agriculture," according to Smit, Ludlow, and Brklacich (1988). Crop yield analysis estimates the effects of altered environments on crop productivity levels and has been employed widely in climatic impact assessments. Spatial analysis examines the implications of climatic warming on the area and location of lands suitable for agricultural production. Agricultural systems analysis assesses the impacts of climatic change on multiple agricultural activities and on the functioning of the agri-food sector, including prices, trade pattern, and employment.

In Climate Change and World Agriculture, Parry (1990) sketches a broad picture of the effects of climate change in the chapter "Effects on Plants, Soil, Pests and Diseases." He argues that the effects of carbon dioxide (CO2) enrichment, without associated changes in climate, would probably be beneficial for agriculture. Higher temperatures, however, could increase the rate of microbial decomposition of organic matter, adversely affecting soil fertility in the long run. Also, studies analyzing the effects on pests and diseases suggest that temperature increases may extend the geographic range of some insect pests currently limited by temperature.

Rosenzweig and Liverman (1992) compare temperate and tropical regions in "Predicted Effects of Climate Change on Agriculture." The regions differ significantly, both in the biophysical characteristics of their climate and soil and in the vulnerability of their agricultural systems and people to climate change. An analysis of the biophysical impact of climate changes associated with global warming shows that higher temperatures generally hasten plant maturity in annual species, thus shortening the growth stages of crop plants. Global estimates of agricultural impacts have been fairly rough to date, because of lack of consistent methodology and uncertainty about the physiological effects of CO2. Table 4 illustrates production changes in wheat using a General Circulation Model scenario and doubling carbon dioxide concentration. Climate change scenarios that do not include the physiological effects of CO2 predict a decrease in estimated national production, but including the physiological effects of CO2 mitigates the negative effects. Tropical regions appear to be more vulnerable to climate change than temperate regions.

Easterling et al. (1993) use another crop modeling technique, the Erosion Productivity Impact Calculator (EPIC), to determine the relationship between climate and crop growth. The authors analyze the results in "Agricultural Impacts of and Responses to Climate Change in the Missouri-Iowa-Nebraska-Kansas (MINK) Region."

Agriculture in the U.S. and other industrialized countries is expected to be less vulnerable to climate change than agriculture in developing nations, especially in the tropics, where farmers may have a limited ability to adapt. In addition, the effects of climate change on U.S. and world agriculture will depend not only on changing climate conditions, but will also depend on the agricultural sector's ability to adapt through future changes in technology, changes in demand for food, and environmental conditions, such as water availability and soil quality. Management practices, the opportunity to switch management and crop selection from season to season, and technology can help the agricultural sector cope with and adapt to climatic variability and change.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter presents the approaches and methods that were used in conducting the study. These include the study design, study population, the sampling techniques and the size, the tools and methods of data collection and mode of data analysis.

3.1 Research design

The study used both descriptive and exploratory research designs to explore and describe the implications of climate change on food security in Lwamaggwa Sub County. These designs were selected because they allow in-depth understanding of the study problem and formulation of justifiable deductions.

3.2 Study population

Lwamagwa is highly populated with close to 45,000 people (Rakai District Development Programme, 2014). The study population included the local population in the area of the ages above 20years and the government officials in the district from the line ministry concerned with agricultural development. It involved county and sub county officials who implement different agricultural programs. This helped to fill the information gaps that could be left by one group of respondents during data collection.

Sample size

A sample size of 120 respondents was used including; 100 farmers (who were both men and women), 5 NAADS representatives, 10 sub county officials and 5 officials from the ministry of agriculture and line departments.

3.3 Sampling approach and sample size

Stratified sampling was used to select a sample from the study population. Each section of the population was taken as a stratum from which a given sample was selected using simple random sampling technique. The strata were farmers, sub county officials and ministry officials such that from each a sample was obtained separately.

3.4 Data collection methods and tools

Key informant interview

Key informant interviews conducted with the ministry and Sub County officials concerned with agriculture development program in Lwamaggwa Sub County. This involved face-to-face discussions with respondents that were guided by unstructured interview guides who gave access to the use of knowledge questions.

Focus group discussions

These were used to collect data from the local people where five groups were established. These were organized with prior arrangements to data collection with the help of local leaders in the area of the study. These groups were involved into discussions with the guidance of a structured questionnaire that was designed in line with study objectives.

3.5 Data analysis

Collected data was analyzed using descriptive statistics to produce simple percentages which were presented in form of tables for further interpretation.

3.6 Research limitations

The researcher experienced a problem of scarce financial resources to run the entire research process. However she tried much as possible to ensure that she improves and solicits from different relative, friends and well-wishers who helped her to raise all the needed money.

The study area was very far from the university which made it difficult for the researcher to travel to the place frequently and this would sometimes necessitate rearrangement of interview schedule times with the respondents. However I managed my time well by drawing a time frame, prior arrangements with the respondents and strict time and financial management from the funds provided by the relatives and friends.

Failure of some respondents to respond to certain research questions was another challenge that the researcher experienced in data collection process, however different logical terms were used by the researcher to ensure that the data is collected from the respondents.

CHAPTER FOUR

PRESENTATION ANALYSIS AND DISCUSSION OF STUDY FINDINGS

4.0 Introduction

This chapter deals data presentation, analysis and discussion of the findings. Data was collected, analyzed and processed to make it useful and understandable. Data was collected, tabulated and then analyzed.

4.1 Socio-demographic Characteristics

4.1.1 Age of the respondents

Respondents were asked questions related to their age and the results are shown in the table below:

Table 1: Showing age distribution of respondent

Age group	Frequency	Percentage
Below 25	10	10
25 - 29	40	20
30 – 39	18	18
40 – 49	30	30
50 – above	22	22
TOTAL	**120**	**100**

Figure 1: Showing age distribution of respondent

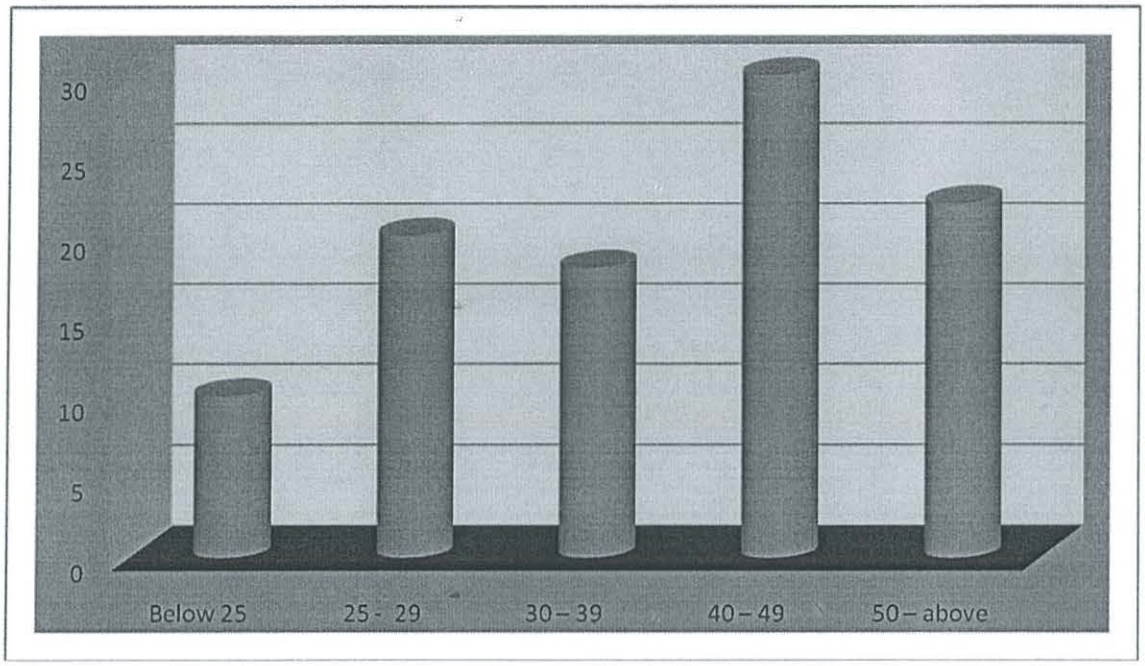


Table 1 and figure 2 above show that 10 out of 100 representing 10% of the respondents were below 25 years, 20 out of 100, representing 20% of the respondents were between 25-29 years of age, 18 out of 100, representing 18% of the respondents were between 30-39 years of age. The table further shows that 30 out of 100 representing 30% of the respondents were between 40-49 years and 22 out of 100, representing 22% were above 50 years of age. This means that majority of the respondents are between 40-49 years of age followed by those above the age of 50.

4.1.2 Marital Status of the respondents

Another variable which was important in respect to the situation of the people in the area was marital status. Information regarding marital status of the respondents was obtained by asking them whether they were married, single, widowed or widowers.

Table 2: Showing marital status of the respondents

Marital Status	Frequency	Percentage
Married	50	42
Single	32	27
Widow	22	18
Widower	16	13
Total	**120**	**100**

Figure 2: Showing marital status of the respondents

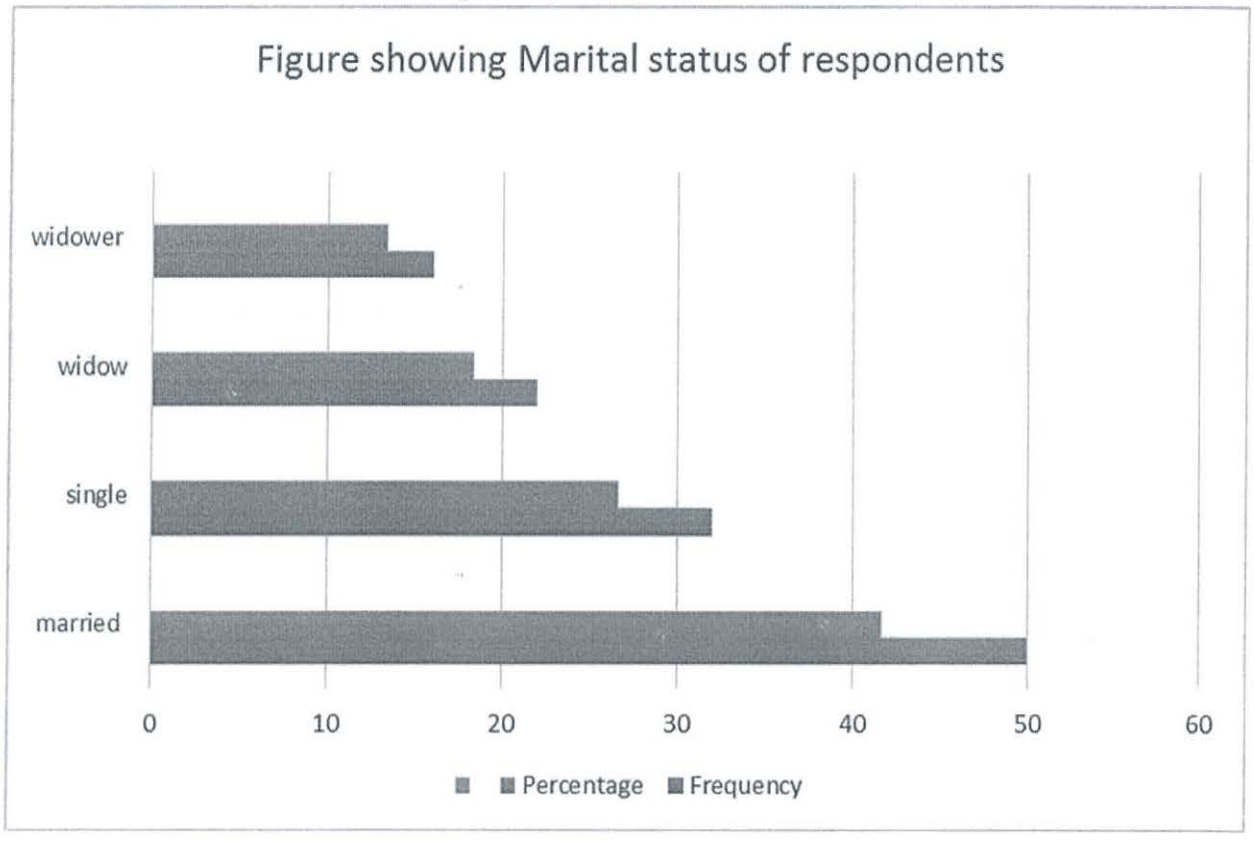


Table 2 and figure 3 above show that 40 out of 100, representing 40% of the respondents were married; 27 out of 100, representing 27% of the respondents were single. It was further showed that 22 out of 100,

representing 22% of the respondents were widows and 11 out of 100, representing 11% were widowers. This means that majority of the respondents were married people followed by a handful of widowers.

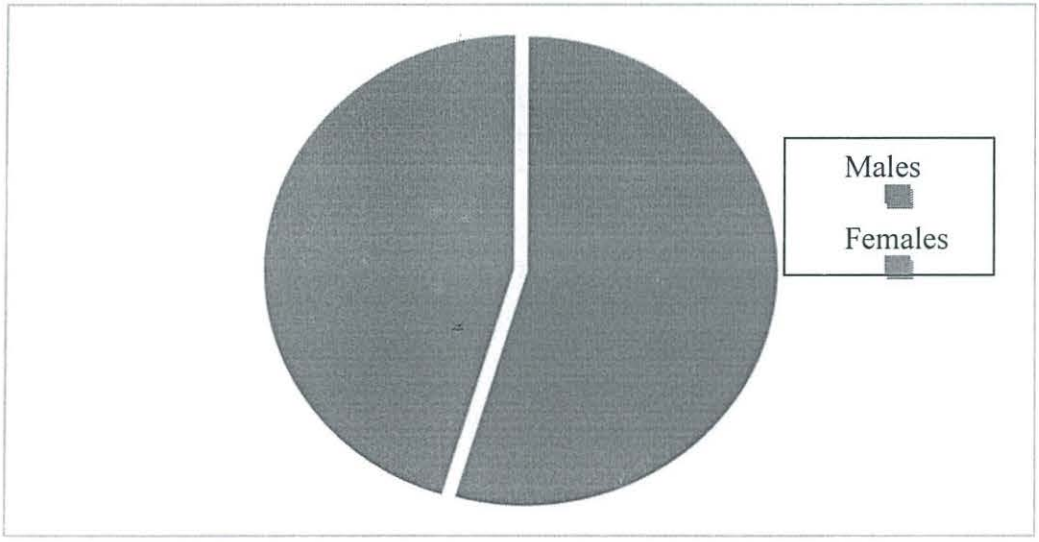
4.1.3 Gender of the respondents

Gender was also another factor which was considered during the study. This is because the researcher was interested in finding out the number of females and males in the whole of the population, and compares the percentage composition of the two.

Table 3: Showing gender of the respondents

Sex	Frequency	Percentage
Female	55	46
Male	65	54
Total	**120**	**100**

Figure 4: Gender of the respondents



Source: Primary data 2014

Table 3 and figure 4 above show the gender of the respondents and it was found that 55 out of 120, representing 46% of the respondents were females and 65 out of 120, representing 54% of the respondents were males. This therefore means that the majority of the respondents are male and the male dominate the respondents with over 60%.

4.1.4 Educational status of the respondents

Respondents were asked questions related to their educational status and their responses are shown in the next page;

Table 4: Showing Educational level of the respondents

Education levels	Frequency	Percentage
Uneducated	20	17
Secondary	25	21
University	35	29
Tertiary	30	25
Total	**120**	**100**

Table 4 and show the educational levels of the respondents and it revealed that 20, representing 17% of the respondents had no education; 25 representing 21% of the respondents had secondary education. The other 35 representing 29% received university education; and 30 representing 20% of the respondents had tertiary education. This means that the majority of the respondents had tertiary level of education as compared to university and secondary education.

4.1 Causes of climate change in Lwamaggwa Sub County

This was intended to find out the causes of climate change as a challenge to food security in western Uganda. This was in line with the first research objective which intended to find out the causes of climate change in Lwamaggwa Sub County.

Table 5: Causes of climate change in Lwamaggwa Sub County

Responses	Frequency	Percentages (%)
Wetland destruction	32	27
Deforestation	45	38
Bush burning	23	19
Encroachment on water bodies	08	7
Carbon emissions	02	1
Use of agriculture chemicals	10	8
Total	**120**	**100**

From the study results shown in table 1 above shows that, wetland destruction is the cause of climate change in Lwamaggwa Sub County. 27% of the responses showed that wetlands in the area had been destroyed paving way for agriculture, settlement and mining which all destroyed the ecological values of wetlands. The water table has been affected due to destruction of wetlands reduced evaporation rates hence reducing the amount of vapour in the air. This makes it hard to from rainfall hence making rainfall seasons to change.

From the study findings, 38% of the responses showed that deforestation was the principal cause of climate change in Lwamaggwa Sub County. Trees have been heavily cut down in the area as a result of high population growth that has resulted into encroachment on the forests. This has been attributed to the nee for firewood and charcoal,

land for agriculture and settlement. This destroys the water balance as the trees play a big role in shaping the climate of the area.

From the table 1 above, 19% of the responses indicated that bush burning is another cause of climate change in Lwamaggwa Sub County. This was as a result of practicing poor farming methods and poor cultural perceptions that communities have in line with bush burning as a way of preparing land for new grass or to make cultivation easy. This burning of the bushes results into the accumulation of carbon gases in the atmosphere hence rising atmospheric temperatures which affects condensation of water vapour and making it difficult for rainfall to be formed.

From the study findings, 4% of the responses showed that poor disposal of wastes was a cause of climate change in Lwamaggwa Sub County. People were not informed about the dangers of poor waste disposal hence people were spreading polythene bags, plastic bottles, human wastes and other organic materials which pollute the environment hence causing disruptions in the atmosphere. This changes the climate patterns in the sense that temperatures and humidity are increased and reduce respectively.

Based on the study results, 3% of the responses showed that encroachment on the water bodies was a cause to climate change in Lwamaggwa Sub County.

4.2 Implications of climate change on food security in Lwamaggwa sub county

This was intended to find out the implications of climate change on food security in Lwamaggwa Sub County and how climate affected crop husbandry in the area.

Table 6: Implications of climate change on food security in Lwamaggwa sub county

Responses	Frequency	Percentages (%)
Pest infestation	21	18
Drying of crops	42	35
Crop rotting	16	13
Destruction of arable land	11	9
Poor crop harvest	30	25
Total	**120**	**100**

Based on the table 2 above, the study results show that climate change had resulted into pest infestation in Lwamaggwa sub-County. This was indicated by 18% of the respondents who agued that because of changes in the climatic patterns, some pests were coming at an unexpected time hence affecting crops. The common pests were aphids, grasshoppers and other insects that destroyed the quality of crop harvests. This caused losses to the crop farmers who solely depended on the sector for their livelihoods.

Based on the study results, 35% of the responses showed that crops were drying in the gardens due to changes in climate in Lwamaggwa Sub County.

4.3 Remedies to climate change problem in Lwamaggwa Sub County

This was aimed at establishing the remedies that were or could be put in place to solve the problem of climate change in central and western Uganda particularly Lwamaggwa sub county.

Table 7: Remedies to solving the problem of climate change in Kakanju sub County

Responses	Frequency	Percentages (%)
Afforestation	36	30
Gazetting wetlands	27	23
Sensitization on waste management	16	13
Environmental education	10	8
Reclaiming wetlands	20	17
Avoid use of toxic chemicals	11	9
Total	**120**	**100**

From the study findings presented in table 3 above, it was found out that

4.4 Measures that can be taken to improve the food security in western Uganda

This was intended to find out the measures that could be taken to improve food security in Lwamaggwa Sub County.

Table 8: Measures that can be taken to improve FOOD SECURITY in Western Uganda Lwamaggwa sub county

Responses	Frequency	Percentages (%)
Use of drought resistant crops	34	28
Early planting of crops	18	15
Use of genetically modified crops	26	22
Irrigation	13	11
Use of fertilizers	29	24
Total	**120**	**100**

From the study results, it was indicated that use of drought resistant crops was a measure that could be taken to improve food security in Lwamaggwa Sub County hence ensuring Food Security in the area.

CHAPTER FIVE

DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter covers the discussion of the research findings which is done according to study objectives. It also draws the conclusions and recommendations of the study.

5.1 Discussion of the study findings

According to study objective one of the study which intended to find out the causes of climate change in Lwamaggwa sub county. The study revealed that climate change was being caused by a number of factors that were economic, social, human and natural. Identified factors included draining of wetlands, cutting down of trees all these being done in an effort to look for land for agriculture, settlement as well as the need for fuel for home consumption. Poor disposal of wastes, burning of bushes and carbon pollution were among other factors that were identified as prime causes of climate change in Lwamaggwa Sub County. These resulted into reduction in rainfall amounts and intensity as well as raising the environmental temperatures due to the destruction of ozone layer and interference with the rainfall formation cycle.

According to study objective two which intended to find out the effects of climate change on the socio-economic livelihoods of crop farmers in Lwamaggwa Sub County, the study found out that climate change affected the livelihoods of crop farmers negatively by causing them loss of investment income, drying of crops prematurely as a result of drought, famine within families that were dependent on crop farming due to poor harvests that could not ensure a stable household food supply. Climate change also resulted into malnutrition of children due

to dependence on one food type that could not allow them have a balanced diet. This made them suffer from nutritional deficiency diseases hence consuming even the little saved money in the treatment of such diseases.

In line with the third objective of the study which aimed at establishing the measures that could be taken to control the effects of climate change from affecting the socio-economic livelihoods of crop farmers in Lwamaggwa sub county, the study was able to establish a number of measures that could be taken to avert the implications of climate change on the socio-economic livelihoods of crop farmers. These included diversification of their economies from overdependence on crop growing to other sectors that can make them safe in case crop growing was affected by climate change. These sectors could be dairy farming, apiary, fish farming, poultry farming, piggery and small scale business.

Growing of quick maturing crops that can be harvested before the drought season could come, adapting drought resistant crops that can bare the conditions within the tropical areas where temperatures are high and rainfall is scarce. This would help farmers to avoid loss of crops that dry prematurely due to inability to survive the drought conditions. Irrigation of farm lands to ensure a steady and continuous supply of water for the crops even in the dry seasons. This could be emphasized by storing water reserves to be used in the dry season to irrigate crops.

5.2 Conclusions

The research draws the following conclusions;

There is a very close relationship between climate and crop farming as change in the prior results into change on the latter. Change in climate results into decline in farm/crop produce hence making lives of people who depend on crops for their survival very complicated.

Climate change was being largely caused by human activities that included the encroachment of the human population onto the fragile ecological; systems that help in the modification of climate like wetlands and forests.

Climate change was a problem to the crop farmers in the area as it made their economies unsustainable by impacting on the out put from the sector and making farmers to loose their incomes after poor harvests and investing in the fragile economy.

Different measures were being used to ensure that crop farmers avoided total loss in case of adverse climate change effects came. However, they had to be used interdependently as one measure would no fully solve the effects of climate change on the overall socio-economic livelihoods of crop farmers in Lwamaggwa Sub County.

5.3 Recommendations

Farmers should be educated on the dangers of destroying the environment as it is the biggest resultant of climate change. This could be done through environmental education so that farmers can be equipped with the skills that could help them in controlling climate change.

The government should endeavor to provide farmers with drought resistant and quick maturing crops that can not be affected by climate change effects. This can be enhanced through research and establishment of demonstration farms where farmers can be able to get such crops from.

People should be prohibited from encroaching on fragile ecosystems that control the stability of climatic factors. This can be done through gazetting wetlands and forests so that they can help in modification of climate.

Afforestation and agro-forestry programs should be emphasized to ensure that the rate of evapo-transpiration can be increased hence increasing the amounts of rainfall necessary for proper crop growth.

Farmers should refrain from using agricultural chemicals that are toxic and which can pollute the environment. This would help to reduce on the carbon accumulation in the atmosphere which would tamper with the ozone layer hence causing global temperature rise.

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DATA COLLECTION TOOLS
KAMPALA INTERNATIONAL UNIVERSITY

INTERVIEW GUIDE FOR LOCAL PEOPLE

1. Names.....

2. Age.....

3. Sex.....

4. Marital status.....

5. Occupation.....

6. How do you find the climate of this area over the past years and today?

.....

.....

7. What do you think are the factors responsible for the change in climate in this area?

.....

.....

8. A part from crop growing, what are the other activities that you are involved in to generate income for the households?

.....

.....

9. How has climate change affected the socio-economic livelihoods of crop farmers in this area?

.....

.....

10. What can be done to solve the problem of climate change in this area?

.....

.....

11. What do you think crop farmers can do to ensure that the socio-economic livelihoods are not affected by the affects of climate change?

.....

.....

Thank you!!

KAMPALA INTERNATIONAL UNIVERSITY
QUESTIONNAIRE FOR ENVIRONMENTALISTS AND LOCAL LEADERS

1. Names.....

2. Age.....

3. Sex.....

4. Marital status.....

5. Designation.....

6. How do you see the trend of things happening on the issue of climate in this area?

.....
.....

7. What could be the factors responsible for the above situation?

.....
.....

8. How has the change in climate affected the growing of crops in this area?

.....
.....

9. What have been the effects of this change on the socio-economic livelihoods of crop farmers in this area?

.....
.....

10. What have you done to help crop framers in combating the problem of climate change?

.....

.....

11. What strategic advice would you give to the crop farmers to ensure that their socio-economic livelihoods are not affected by climate change?

.....

.....

Thank you very much!!

APPENDIX B: BUDGET

Item	Quantity	Cost per unit	Total cost
Duplicating papers	2 reams	13500=	27000=
Research assistants	2 for three days	100,000= @ day	200,000=
Ruled papers	1 ream	15,000=	15,000=
Transport	3 times for 3 people	6,000=@day	48,000=
Communication		20,000=	27,000=
Stationery			20,000=
Typing and printing	3 copies	12,000@	36,000=
Binding	3 copies	10,000@	30,000=
Food and accomodaton			100,000
Miscellaneous		40,000=	40,000=
Total		**111,800=**	**573,300=**