INFLUENCE OF CLIMATE CHANGE MITIGATION STRATEGIES ON RURAL LIVELIHOODS OF KURESOI DISTRICT COMMUNITY, NAKURU COUNTY KENYA

BY

SYLVESTER ODUOR ABARA

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DECLARATION

This research report is my original work and has not been presented for award of degree in any other University.

Signed …….. Date ……

Sylvester Oduor Abara

L50/65996/2010

This research report has been submitted for examination with my approval as the university supervisor.

Signed …… Date ……

Professor T. Maitho

Department of Public Health, Pharmacology and Toxicology,

University of Nairobi

DEDICATION

I would like to dedicate this work to my beloved Wife Grace Oduor and my twin daughters Michelle Mutheu Oduor and Whitney Mangla Oduor for standing firm with me and friends who supported me to make this research a success.

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I therefore appreciate the responsibility, knowledge and skills used in production of this document as my original work and commit its communication to entire University of Nairobi fraternity, all scholars, government, Non-governmental Organisation, Intergovernmental organisations, private sectors and support in implementation of research process

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ABBREVIATIONS AND ACRONYMS

CBO	Community Based Organization
CC	Climate Change
CDF	Constituency Development Fund
COFCCA	Congo Basin Forest and Climate Change Adaptation
COP	Conference of Parties
DC	District Commissioner
EMCA	Environmental Management and Coordination Act
FAO	Food and Agriculture Organization
GHG	Green House Gas
IPCC	Intergovernmental panel on Climate Change
IUCN	International Union for Conservation of Nature and Natural resources
KFS	Kenya Forest Service
LDC	Least Developed Countries
NAPA	National Adaptation Plan of Action
NCCRS	National Climate Change Response Strategy
NGOs	Non-Governmental Organizations
NSC	National Steering Committee
NTFP	Non-Timber Forest Products
NYCCC	National Youth Conference on Climate Change
PC	Provincial Commissioner
PPF	Provincial Peace Forum
REDD	Reduction of Emission through Deforestation and Degradation
SID	Small Islands Developing States
UFCCC	United Nation Framework Convention for Climate Change
UNEP	United Nation Environmental programme
UNEP-DELC	UNEP- Division of Environmental Law and Convention
US	United States
USAID	United States Agency for International Development

ABSTRACT

This study addresses the influence of climate change mitigating strategies on rural livelihoods of Kuresoi District community, Nakuru County in Kenya. Climate change is a major challenge on livelihoods among communities living along Mau forest at Kuresoi district in Kenya. Most of the environment warming effect occurring over the last 50 years is likely to have been caused by human activities. The objectives of this study were: to determine how adaptations as a climate change mitigation strategy influences rural livelihoods, to examine how training and awareness as a climate changes mitigation strategy influences rural livelihoods, to examine how conservation as a climate changes mitigation strategy influences rural livelihoods and to analyze how structural arrangements as a climate change mitigation strategies influences rural livelihoods. The study adapted both qualitative and quantitative research design where questionnaires were used to collect data from 108 respondents that came from youth community organizations, Community based Organization and Kenya Forest Service in Kuresoi district. Raw data collected was and analyzed using Statistical Package for Social Scientists where by frequency and cross tabulation tales produced. The results shows that most local organizations in Kuresoi district are involved in identifying adaptation strategies to address the effect of climate change as well as being aware of climatic changes taking place in their locality and have taken steps to discuss climate change issues within their neighborhood through Chief Barazas. Tree planting is the most common environment conservation strategy whose effect plays a great role in mitigation climate change problems. Conservation strategies have impacted positively in mitigating the effect of climate change thereby improving community livelihoods. There is a need to scale up and diversify funding allocations by both government and NGOs from the current 58% to over 80%. Also support to local approaches like community discussions through Chief barazas and neighbours will enhance awareness among community members. Community members with incomplete secondary education and below should be targeted and motivated to participate in climate change forums which should take into account relevant climate change issues and use of community devolved funds like CDF. Increased support to conservation strategies like tree planting for catchment to be encouraged along Mau Forest, schools and public space. This study will assist in formulating policies and programmes towards Climate change as well as enhancing rural livelihoods of Kuresoi District Community members.

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Climate change has become one of the environmental threat across the world with the witnessing of the increased global air, oceanic temperatures, wide spread melting of snow and ice and rising sea levels (IPCC, 2007). This affects less industrialized regions impacting on livelihoods of the rural households which tend to rely heavily on climate sensitive resources such as water supplies and agricultural land; climate sensitive activities such as arable farming and livestock husbandry; and natural resources such as fuel wood and wild herbs (PRB, 2007). Climate change may reduce the availability of these local natural resources, limiting the options of rural households that depend on Natural resources for consumption or trade. Lands becomes less fertile, fewer reeds for basketry and less fuel wood for cooking. There is need for creating awareness to rural communities on the climate changes.

In Africa, farmers in warmer and drier Sahelian regions have already curtailed their cropping season (IPCC, 2007). Yields from rain-fed agriculture are expected to fall as much as below 50 percent in some poor African countries. According to the same IPCC report, fisheries will likely to decline. This is expected to affect the rural livelihoods of Latin America too. Climate change is noted to be spurred by anthropogenic activities such as Green- house Gas emissions through burning of fossil fuel and transportation representing 3.9% of the world's total (IEA, 1999). Deforestation alone account for major part of Africa GHG emissions and compared to industrialized countries of Europe and North America.

Much of the Africa's focus on climate change has been on the vulnerability of the region due to low human capacity to adapt to anticipated increased extreme events, resulting from widespread poverty, heavy reliance on the rain fed agriculture, inadequate technological and economic resources and insufficient safety nets and educational progresses (IPCC, 2011; Sokona and denton, 2001; Tsachakert, 2007). African nations have responded to the need to address climate change and thus some have already

become signatories of united nation framework Convention for Climate Change (UNFCCC). Climate change is viewed as a threat to rural livelihood and this has the capacity to undo many years of development in Africa. In Kenya, this phenomenon is already unmistakable and intensifying at an alarming rate and this is evident from countrywide temperature increases and rainfall irregularity and intensification (COP 16 Report, 2010) .These affect resources critical for economic development, for instance 1999/2000 La'nina drought, which left approximately 4.7 million Kenyans facing starvation (NCCRS, 2010). In early 1960s, Kenya has generally experienced increasing temperatures over vast areas. Over inland areas, the trend is both minimum through night and early morning and maximum at day time. This depicts a general warning. Annual rainfall event indicates that 24 hour rainfall amount experienced today is lower than those of 1960s (NCCRS, 2010). This changing temperatures and rainfall patterns have profound impact on Kenya Socio-economic sectors most of which are climate sensitive. These key sectors include; agriculture, rangelands which are backbone of Kenya's pastoralists, wildlife and tourism sector, forestry, water resources, aquatic and marine resources, health as well as physical and social infrastructure. Climate change is already ravaging Kenya and evident by increase in incidences such as flooding, spread of disease like Malaria and erratic rainfall patterns.

Global greenhouse Gas (GHG) emissions are continuing unabated and this is seen to worsen the impact of climate change if it is not addressed. If Kenya takes no action to minimize the impact of current and future climate change, the cost of potential damage to economy would be enormous. According to a recent study, direct cost of climate change in Kenya will potentially amount to between one to two billion US Dollars annually by the year 2030 and considerably greater if indirect costs are included. Climate change impacts portend an increasingly worsening and worrying situation in the future if Global and national efforts are not enhanced to reverse atmospheric GHG emissions which accelerate global warming.

1.1.1 Climate Change and Rural Livelihoods in Kuresoi district

Kuresoi district is in the West of newly created Molo district and Borders expansive Southwestern block of Mau forest. It is a native reserve of the Kalenjin Community and

Minority Ogiek who in early 1890s were alienated by colonists to pave way for white settlers. In the meantime, white settlers brought in Kikuyus to work on their farm. Today Kuresoi is a home of assorted tribes who include Kikuyu, Kalenjin, Gusii, and Luhyas (Kuresoi Analysis Report, 2009).

The main livelihood activities of these people are crop farming which is mainly by Kikuyus, Kalenjin and Gusii. Bee keeping, Hunter-Gathering and sourcing of Herbal is mainly practiced by the Ogiek who are the minority tribe in the district and also the forest dwellers (USAID/Promara, 2010). Livestock farming is mainly practiced by the Kalenjin community although Kikuyu and Gusii communities practice it on a limited scale. All these livelihood activities rely heavily on rainfall for water supply, fertile soil for growth of pasture and availability of indigenous trees and widespread forest cover for herbal medicine and fuel wood and bee keeping for Forest dwellers, Ogiek.

1.2 Statement of the Study

Climate change is increasingly taking center stage of discussions as one of the great challenges facing humanity of this century in both developed and developing countries. In Kenya, this is already intensifying at an alarming rate evident from countrywide increase in temperature and rainfall irregularity and intensification. An example is La'Nina drought 1999/2000 which left approximately 4.7 Kenyans facing starvation. In addition, increased average temperature has led to spread of vector borne diseases like Malaria to areas where disease is not known to be endemic (NCCR, 2010). Several international instruments have been put in place to aid the process of addressing this phenomenon (Promara, Mau Assessment report, 2010). These instruments include IPCC, UNFCCC and Kyoto protocol. Several climate change negotiations have been conducted with the latest one being Conference of parties (CoP 17) held at Durban, in South Africa in the Year 2011. Like for the case of Kenya, instruments include; The Recently adopted National Land Policy, Environmental management and coordination Act, Vision 2030, the Kenyan Constitution (2010), Wildlife conservation and management Act and Local Government Act. According to Shiwarti (2007) and Somorin (2010), the effect of climate change on rural livelihood is intensifying, resulting to death, among other inhuman

copying mechanism. This has been witnessed from decline in agricultural production, increased nomadic by pastoral communities in search of pasture, unpredictable rainfall pattern and reduced water supply in the area. This has attracted the attention of both location and international conservation specialists/organizations to inject their funds on restoring Mau forest alongside conservation of Mara River so as to boost agricultural production along Mau Forest.

In the case of Kuresoi District of Nakuru County in Kenya, Climate change is as a result of destruction of Mau forest which is the main water tower that supports livelihood activities in the district. These livelihood activities include; farming of Potatoes, Kales, Cabbage, Maize and Tea; dairy farming; bee keeping, fuel wood; Herbal medicine; and Water Resources (USAID/Promara, 2010). Irregular rainfall patterns, and continued excision of Mau forest has resulted to low water supply leading to poor performance in agricultural production. Areas of Mau forest along Kuresoi District are characterized by illegal logging and settlement of people into the forest. Efforts to conserve the forest which is the main water tower that support livelihood activities have been frustrated by over politicized evictions and resettlements, illiteracy, continued ethnic conflicts and poverty (Obare et al, 2009). This study assumed that the findings will inform policy makers, Government of Kenya, scholars, learning institutions, People of Kuresoi and development agencies among other stakeholders working in the area on appropriate strategies that can be adopted to avert climate change as well as improving food security and secure livelihoods of people in Kuresoi districts.

1.3 Purpose of the Study

The purpose of the study is to identify influence of climate change mitigations strategies on rural livelihoods of Kuresoi district community.

1.4 Research Objectives

Objectives of the study are;-

1. To determine how adaptations as a climate change mitigation strategy influences rural livelihoods of Kuresoi District community.

2. To examine how training and awareness as a climate changes mitigation strategy influences rural livelihoods of Kuresoi district community.
3. To examine how conservation as a climate changes mitigation strategy influences rural livelihoods of Kuresoi District community.
4. To analyze how structural arrangements as a climate change mitigation strategies influences rural livelihoods of Kuresoi district community.

1.5 Research Questions

The Research questions are;-

1. How does adaptation as a climate change mitigation strategy influence rural livelihoods of Kuresoi district community?
2. How does training and awareness as a climate change Mitigation Strategy influence rural livelihood Kuresoi district community?
3. How does conservation strategies influence climate change Mitigation Strategies on rural livelihood of Kuresoi district community?
4. How does structural arrangements as a climate change Mitigation Strategy influence rural livelihood of Kuresoi district community?

1.7 Significance of the Study

This study will come up with findings which will be expected to help development agencies, scholars, learning institutions to improve on teaching content, the government of Kenya among other stakeholders in formulating policies and programmes towards responding to climate change as well as enhancing rural livelihoods of community members of Kuresoi district community.

1.8 Basic assumptions of the study

The study assumed that all respondents gave accurate information. Climate change reduces availability of Local natural resources thus limiting the options for rural livelihoods that depends on natural resources for consumption and trade (Hunter, 2007). The researcher assumed that climate change has had effect on rural livelihoods of community members at Kuresoi district.

1.9 Limitations of the study

The research was limited in several ways;-

Poor infrastructure in Kuresoi district was a bit of a challenge during data collection due to lack of public transport. There is no public transport in the interior areas due to bad roads. The researcher made use of a local youth who are conversant with the area to help in data collection around the district. Secondly, language barrier arising from the rural community members of Kuresoi mainly being Kalenjin and also the high rate of illiteracy was earlier seen to be a threat to the research. However, to overcome this, the researcher involved one community resource person to help with translations. In addition, unwillingness of respondent to provide information, this is because of conflict of interest among the respondents; for instance Kenya forest service officers and some community members for information given. They agreed to share information after explaining to them the purpose of the research which is purely for academic purposes.

1.10 Delimitation of the study

The concept of the study was to find out the influence of climate change mitigation strategies on rural livelihoods of Kuresoi district communities in Kenya. The study was confined to Kuresoi district mainly looking at the adaptations strategies, training and awareness, conservation strategies and structural arrangement and their effect on rural livelihoods. Information was obtained from journals, books and other sources of climate change on rural livelihoods.

1.11 Definition of significant terms as used in the study

For the purpose of this study, the following meaning is attached to the following terms;-

Adaptation Strategies

Implies in how communities respond to the influence of climate change mitigation strategies on rural livelihoods. The strategies enable individuals or the community to cope with or adjust to the effect of climate change. These may include adoption of hardy variety of crops, early planting, and selective keeping of livestock.

Climate Change

Long term changes in the average weather patterns of a region observed over a period of time. This is an environmental, social and economic threat facing our world today observed from rising temperature; wide spread melting of snow and ice, global rise in air and sea levels. This is caused by Green House gas emissions and destruction of water catchment areas by deforestations, forest degradation, illegal logging and settlements and encroachments into the forests (IPCC, 2009). In this study, the community affected is Kuresoi district whose water tower is Mau forest. Climate change affects soil fertility, availability of water, increased diseases, flooding, and drought among other extreme conditions.

Communal pooling

Refers to responses involving joint ownership of assets and resources; sharing of wealth, labour or income from particular activities across households, or mobilization and use of resources held collectively during times of scarcity

Community Based organizations

In this study, Community Based Organizations (CBO) refers to grassroots organizations initiated by community members themselves. These include youth self-help groups, Youth Congress, women groups, local associations and Kenya forest associations. These local institutions participates in implementing climate change response strategies at grass root level in Kuresoi district

Conservation Strategies

These are plans or methods used in conserving the Mau forest and Mara River which is the Main water Tower for Kuresoi district to avert the challenges of Climate Change on rural livelihoods. Conservation strategies involve reforestation, conflict resolution and management between forest dwellers (The *ogiek*) and the Kenya Forest Service (KFS).

Diversification

Way of reducing risks across assets owned by households or collectives. Highly varied in form, it can occur in relation to productive and non-assets, consumption strategies and employment opportunities. It is reliable to the extend benefit flows from assets are subject to risks and risks have different impacts on the benefit streams from different assets.

Livelihoods

These are sources of economic and development activities of a community supported by natural resources such as forest resources, water catchment and soil fertility. In Kuresoi livelihood rely heavily in the water tower being Mau forest. Livelihood activities include hunter-gathers, bee keeping, agriculture, and livestock keeping, souring of herbal medicine from the Mau forest and sourcing of fuel wood. These activities raise income level as well as promoting the well-being of a community. According to Olofunso (2010), livelihoods contribute to human well-being, which include tangibles assets and good consumption. Chambers and Conway (1992) gave the following definition of livelihood 'A livelihood comprises capabilities, assets (both Material and Social resources) and activities required for a means of living. A livelihood is stable when it can cope with and recover from shocks and stresses and maintains or enhance its capabilities and assets, both now and in future, while not undermining the natural resource base'.

Greenhouse Gases

The green house gases (GHG) which are responsible for climate change consists of Carbon dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O), Tropospheric Ozone (O_3) and Hydro fluorocarbons (HCFCs). The principle way in which these gases operate is to prevent the escape of heat initially received from the sun by the earth's surface, as short wave energy back to space. GHG contribute to climate change and are responsible for floods/flash floods, droughts, famine, an upsurge in tropical diseases and heat waves occurring across the world. GHG are

products of industry, transportation as well as changes in land use. Approximately 70% of all GHG that have accumulated in the earth's atmosphere have been put there by US and Europe. US alone is responsible for 35% of the total GHG while Africa is responsible for less than 3% (Kenya NYCCC Report, 2010)

Mobility

This implies common and seemingly natural response to environmental risks. It pools or avoids risks across the space, and is especially successful in combination with clear information about potential precipitation failures.

Structural arrangements

This refers to the community institutions such as Community based organizations, civil society organizations, NGOs, government policies, adherence to ratified international conventions and commitment of both the local and government key departments responsible to addressing the issues of climate change.

1.12 Organization of the study

This study was organized into five chapters. Chapter one is introduction of the study. It focused on the background of the problem, statement of the problem, purpose of the study, and the research questions. The Chapter also dealt with the significance of the study; limitation and delimitation of the study; basic assumptions of the study; definition of terms used in the study. The second Chapter entailed review of related literature review. Literature review is organized in themes related to the influence of climate change mitigation strategies on rural livelihoods. These themes in includes; adaptation strategies; training and awareness; conservation strategies and structural arrangements. The third chapter dealt with methodology, the researcher describes research design, target population. This chapter also contains description of instruments that were used for data collection, validity and reliability of those instruments, data collection and analysis procedures. In the fourth Chapter, the researcher presents data analysis and of data collected from research. The researcher states the findings and also investigates and

interprets the implication of the results with respect to research questions. In chapter five, the researcher gives a summary of the findings, discussion, conclusions, recommendation and suggests areas of further studies.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter indicates the existing theoretical and empirical literature that relates to the topic of the study. The literature mainly deals with climate change mitigation strategies in relation to adaptation strategies, trainings and awareness, conservation strategies and structural arrangements. It also dwells on the government policies that may influence rural livelihoods.

2.2 Climate Change

Climate change refers to long term changes in the average weather patterns of a region observed over a period of time. This is an environmental, social and economic threat facing our world today observed from rising temperature; wide spread melting of snow and ice, global rise in air and sea levels. The earth's average surface temperature had risen by 0.76^{o}C by 1850. Most of the warming which has occurred over the last 50 Years is likely to have been caused by human activities. In its fourth assessment report, the Intergovernmental Panel on Climate Change projects that without further action, to reduce green gas (GHG), the Global average surface temperature is likely to rise by further 1.8^{o}C to 4.0^{o}C this century. And Even the lower end would take the temperature increase since pre-industrial times above 2^{o}C, the threshold beyond which irreversible and possible Catastrophe changes become far more likely. Africa's contribution to climate change is relatively small and approximated to be 7% in 1990, with Land use changes. Emissions from burning of fossil fuel is only 3.9% of the worlds emission whereas deforestation alone account for a major part of Africa's GHG emission compared to industrialized countries of Europe and North America, where Africa's contribution to global climate Change is not significant.

This is caused by Green House gas emissions and destruction of water catchment areas by deforestations, forest degradation, illegal logging and settlements and encroachments into the forests (IPCC, 2009). In this study, the community affected is Kuresoi district

whose water tower is Mau forest. Climate change affects soil fertility, availability of water, increased diseases, flooding, and drought among other extreme conditions.

2.3 The Concept of Adaptation Strategies

According to Arun (2008), Natural resource dependent rural households are likely to ensure a disproportionate burden of the adverse effect of climate change; droughts, famines, floods, variability in rainfall, storms, coastal inundation, ecosystem degradation, heat waves, fires, epidemics and even conflict. In some parts of the world these effects may be already in play with potential disastrous consequence for the poor (Adger et al., 2007). Many households in vulnerable region could periodically be driven into destitution and hunger and find it difficult afterwards to recover. There is need for a policy framework for examining adaptation practices in the context of rural livelihoods and this need to be sufficiently general to cover many empirical examples of adaptation practices used in by different social groups but also need to take into consideration the most important characteristic of impact of climate change on rural livelihood.

Climate change is likely to manifest around increased risks to rural livelihoods. These are thus classified into the following four types which are; across space, over time, across set of classes and across households (Arun, 2008). The basic copying and adaptation strategies in the context of livelihoods risks can correspondingly be classified into mobility, storage, diversification and communal pooling. Additionally, where Households and communities have access to markets, market-based exchange can substitute for any of the four classes of adaptation strategies above (Agrawal, 2008, Halstead and O'shea, 1989). Where successful, these responses either reduces spatial, temporal, asset related and community level risk directly or reduces them by pooling uncorrelated risks associated with the flow of livelihoods from different sources. UNFCCC conducted assessment from a number of countries to explore the nature and distribution of adaptation responses and adaptive capacities in poorer countries of the world. This is indicated in Table 2.1.

Table 2.1: Major classes of Adaptation Practices

Class of Adaptation	Corresponding Adaptation Strategy
Mobility	1. Agro-pastoral migration 2. Wage labour migration 3. Involuntary migration
Storage	1. Water Storage 2. Food storage (crops, seeds, forest products) 3. Animal/live Storage 4. Pest control
Diversification	1. Asset portfolio diversification 2. Skills and occupational training 3. Occupational diversification 4. Crop choices 5. Production technology 6. Consumption choices 7. Animal breeding
Communal pooling	1. Forestry 2. Infrastructure development 3. Information gathering 4. Disaster preparation
Market exchange	1. Improved market access 2. Insurance provision 3. New product sales 4. Seeds, animals and other input purchases

Adopted from Arun Argawal (2008): Climate Adaptation, local institution and rural livelihoods

Adaptation is increasingly receiving attention under united Nation Framework Convention on Climate Change (UNFCC). This is seen from establishment of Nairobi Work Programme on impacts, vulnerability and adaptation to climate change was established under the Subsidiary Body for Scientific and Technological Advice (SBSTA)

in 2005. This was a five year programme with an aim of assisting all parties to the convention, especially developing countries, LDCs, and SIDS on matters regarding improvement of understanding and assessment of impacts, vulnerabilities and adaptation; and to make informed decision on practical adaptation actions and measures (UNFCCC, 2008).

Adaptation was also identified as one of the five building blocks for strengthened future response to climate change in Bali Action Plan. Many LDC have developed NAPAs which identify priority intervention areas win response to impact of climate change (Campell A et al, 2008). Although funding has been allocated for adaptation strategies, this has been seen to be inadequate. The Estimated sums needed to fund adaptation range from $10-86 billion per year. These estimates are orders of magnitude higher than the sums generated under the existing funds (Ayers and Huq, 2008; Harmeling and Bals, 2008).

2.3.1 Adaptation to Water Stress

Impact on water resources has been noted to be a likely problem of climate change. Inadequate water will lead to drought and desertification whereas too much water leads to flooding (FAO, 2007). Desertification is considered to be one of the most threatening processes to livelihoods of the poor (MA 2005b) with more than 300 million Africans living in drought or drought-prone areas; a number likely to be increased in Africa and on a global scale due to climate change (IPCC, 2007).

A new report projects that by 2030, 47% of the world population will be living in areas of high water stress, especially in Africa, with 24 to 700 million people expected to be displaced because of water scarcity (UNESCO, 2009). This is noted to have more impact in Africa, with adaptation costs in the sub-Saharan urban water sector estimated at between 10 and 20 per cent of current overseas development assistance to the region (Muller, 2007). Adaptation options for water shortage range from water use controls to the building of reservoirs and diversion of rivers into drought prone areas (Obersteiner, 2006). Reduced vulnerability to drought, particularly ASAL regions, requires improved

soil and water management (Falkenmark and Rockstrom, 2008; Stringer, 2008). The regulation of water flows in dry land regions have been strongly linked to the proportion of land covered by forest, grassland, and wetland, and maintaining vegetation cover can assist in adaptation to drought (Falkenmark and Rockstrom, 2008). Upland watersheds play a vital role in water regulation. Run-off from mountainous areas in SIDS is often the major supply of water (Mata and Budhooram), and in the Phillipines, watersheds are a critical part of the national economy (Lasco et al, 2008). Often these watersheds are degraded, and their rehabilitation is one adaptation option (MacKinnon, 2007). Planting trees on slope fields, mini-terracing for soil and moisture conservation, and improved pasture management can also complement actions such as building of small-scale infrastructure in water resources management (World Bank, 2008). Natural resource management has been included in the NAPA of the Niger, where water stress is the major issue, and the reduction of pressure on freshwater resources is receiving attention in Brazil where the use of pesticides has impacted water quality in many areas (Hedger and Cacouris, 2008). Soil erosion measures such as conservation tillage can be coupled with rain water harvesting and are activities that can be undertaken by communities (Paavola, 2008).

2.3.2 Adaptation to flooding

Watersheds can reduce flooding and sedimentation whilst improving water quality downstream. A study of upland forests in a watershed in Madagascar has estimated their flood protection value at $126,700, and peat bog in Sri Lanka that buffers floodwaters from rivers have an estimated annual value of more than $5 million (Emerton and Bos, 2004; Sudmeier –Rieux, 2006). In the Morogoro region of Tanzania, reduced river flow and increased flooding has been attributed to deforestation in the mountains, and it has been suggested that effective governance of soil, forests and water resources are needed as adaptation measures, along with improved social capacity (Paavola, 2008). Ecuador and Argentina have integrated forests and wetlands into their ‘living with floods’ strategies (World Bank), and reforestation is recognized as an important option for adaptation in the watersheds of the Phillipines (Lasco et al., 2008). Viet Nam includes measures such as integrated management of watersheds in its disaster reduction planning,

along with forest management, and soil and water conservation (Sudmeier-Rieux, 2006). Large-scale a forestation projects in China have been carried out with the aim of reducing flooding and increasing water conservation, and countries of Central America are collaborating to protect watersheds and forest (Abramovitz et al, 2006).

Ecosystem management is also an effective adaptation strategy at the river basin scale and can be an alternative to the development of dams, which have a high environmental impact. (Mata and Budhooram, 2007). In developed countries, cost effective flood reduction strategies that allow re-growth of vegetation alongside rivers and establish vegetation buffers along streams, combined with the reduced development of infrastructure, and are being promoted in some areas (Nelson et al, 2008). Some evidence that this can be an effective strategy has been provided in a modeling scenario exercise, which suggested that a combination of wetland restoration and hard defenses provides optimal flood protection (Berry et al, 2008). Riparian floodplains can also help to reduce the levels of water pollution following extreme events (CCSP, 2008). In Europe, the conservation or restoration of river floodplains has been included in a number of flood reduction strategies (Zaunberger, et al, 2009), although there are many new river management plans that do not include such measures (Krysanova et al, 2008).

2.3.3 Adaptation in Agriculture

Food production is climate dependent economic activity. Climate change is already affecting agriculture in developing countries and this is anticipated to worsen if no action is put in place (IPCC, 2007), with significant impacts on crop yields and the productivity of grazing lands and livestock expected, through changes in temperature, precipitation, water availability, salinity, and the abundance of pollinators , pests and diseases (Rosenzweig and Tubiello, 2007). Impacts vary across regions and require a number of different adaptation strategies (Berry et al, 2008). Agricultural production is the main economic activity for rural communities of vulnerable regions such as Africa and India (Chatterjee, et al, 2005; Osbahr et al, 2008). In some countries in Africa, yields from rain-fed agriculture could be reduced by up to 50 per cent by 2020 (IPCC, 2007). In Central and South Asia, crop yields could fall by as much as 30 per cent by 2050 as a result of

climate change; India alone could lose 18 per cent of its rain-fed cereal production (Lobell et al, 2008). For agriculture in the world's dry lands, the challenges are especially large due to unpredicted changes in hydrological cycles characterized by both increased droughts and increased risks of flooding (Falkenmark and Rockstorm, 2008). Depending on the region and the available resources, options for adaptation range from relatively inexpensive changes, such as shifting planting dates or switching to an existing crop variety, to much more costly measures including the development of new crop varieties, increasing chemical and other inputs and irrigation systems (Rosenzweig and Tubiello, 2007). The options for adaptation in agriculture include: changes in the locations of cultivation (opening new areas for cultivation); changes to the crops cultivated, including substitution by new crops, new varieties and crop diversification; and changes to agricultural practice, including irrigation and soil management regimes and the use of agricultural inputs. Biodiversity plays an especially strong role in supporting the latter two.

2.3.4 Forest Adaptations

Climate change discussions focus on mitigation, rather than adaptations (Guariguata et al, 2008). Although there is a wealth of literature on the ecosystem services provided by forest and the links to livelihoods, little is explicitly related to climate change adaptation. Much of the literature that does exist is related to management of temperate forest (Locatelli et al, 2008). However, the role of forests in societal adaptation is becoming increasingly recognized (Eliasch, 2008), and has led to the development of initiatives such as the Congo Basin Forest and Climate Change Adaptation (COFCCA) project. Solidifying the links between forests and adaptation will be important to reduce damaging management practices that could lead to mal-adaptation in the longer term (Nkem et al, 2007).

Forests can contribute to adaptation in the following three main ways; through structural defense against wind and soil erosion, through water regulation, and through the provision of timber and non-timber forest products (NTFPs) (Ogden and Innes, 2007; Innes and Hickey, 2006; UN, 2008; WRI, 2008; McEvoy, Lindley and Handley, 2006;

Paavola, 2008; Eriksen et al, 2006), as has been discussed in previous sections. On a local scale, forests can provide shade and reduce exposure to heat; for example, a study in Kenya found that improved microclimate and catchment properties of a hilltop area were closely linked to good biodiversity status of the forest (Eriksen et al, 2006). Conversely, deforestation is a driving force for loss of ecosystem services and land degradation (Cangir and Boyraz, 2008). Forest dwellers and those that rely on forest resources are often the poorest members of society and have low adaptive capacity (FAO, 2007; Ravindranath, 2007). Where access to NTFPs become marginalized, vulnerability of the poorest people increases (Eriksen et al, 2005; Paavola, 2008). Both natural and plantation forests can provide 'safety nets' during periods of food shortage, and can provide an important contribution to food security (Kalame et al, 2009; Nkem et al, 2007). Community involvement in a forestation projects, for example, can diversify incomes and improve social capacity, reducing the vulnerability to climate change impacts (Guariguata et al, 2008; Spittlehouse, 2005).

Forests can be particularly important during extreme events. In addition to the provision of 'safety nets', it has been suggested that forest cover can reduce landslide erosion by a factor of 4-5 compared with sites that lack substantial tree root strength, and reduce flooding (ProAct Network, 2008; ISDR, 2004). In a study of North Pakistan, it was estimated that 56% of all landslides were due to land degradation from deforestation and grazing, and that protective forests would be a cost effective action to reduce disaster risk (Sudmeier –Rieux et al, 2007).

In the Amazon, forest has a major role in the regional hydrological regime (Correia et al, 2008). Forest loss could push some sub regions into a permanently drier climate regime, increasing vulnerability of societies to drought conditions (Malhi et al, 2008; Betts, 2007). Recent research has suggested that there is potential for large scale die-back of the Amazon rain forest through a combination of degradation and drought (Nepstads et al., 2008; Philips et al 2008), although it is thought that in-tact forests will be more resilient to climate change impacts (Bush et al, 2008; Malhi et al. 2008; Gullison et al, 2007). Forest management and conservation practices may help to decrease the

vulnerability of those who depend on forest services for their livelihoods, while at the same time maintaining the mitigation capacity of forests (Guariguata et al, 2008; IUCN, 2008). Adaptation in the forest sector (for both natural and plantation forest) can either enhance resistance and resilience of existing forests to climate change, or facilitate adaptation to new conditions (Locatelli et al 2008). Other adaptation options include diversification of the forest economy and the forecasting of potential pest impacts (Ogden and Innes 2007; La Porta et al 2008).

Climate change is rarely factored into forest planning (Nitschke and Innes, 2008), possibly due to the uncertainties surrounding the vulnerability of forests to climate change (Chapin et al., 2007; Millar, Stephenson and Stephens, 2007). A mixture of adaptation measures will be required, depending upon whether the goal is to manage for a specific ecosystem service, or for resilience in general (Locadelli et al, 2008). Although a number of adaptation measures have been proposed (Locatelli et al; 2008; Guariguata et al., 2008; Millar ,2008;Noss, 2001;Ogden and Innes, 2007), most of the management practices suggested to date have been generic and based on temperate case studies (Kalame et al, 2009). Adaptation to climate change is a relatively new field, and the literature available in this area is limited. Very few adaptation strategies have actually been implemented, but those that have tend to rely on technological and engineering measures**.** The limited evidence to date suggests that although technological and structural adaptation measures will be required, biodiversity will also play a vital role in adaptation to climate change (Campell et al., 2008).

In addition, climate change impacts can be exacerbated by management practices, such as the development of seawalls, flood management and fire management that do not consider other sectors such as biodiversity conservation and water resource management; this results in mal-adaptation in the longer term (World Bank, 2008; Hulme, 2005). Furthermore, the use of technology and infrastructure can 'lock in adaptation' to a specific impact, whereas the incorporation of 'soft' adaptation measures, including land use planning, natural resource management, and building social adaptive capacity, can allow for flexible responses (Kirshen et al, 2008). Integration is required not just between

biodiversity-based adaptation and technological measures, but also across different adaptation sectors, and will require significant institutional support.

2.4 The Concept of Training and Awareness

Climate change being an environmental, political and socio-economic phenomenon in the world rendering countries vulnerable has impacted negatively on rural communities livelihood as the level of understanding and awareness on the issues is very limited (Bhola, 2009). In order to respond to climate change, rural communities are compelled to act immediately and respond to such changes in order to reduce the impacts on their livelihoods. It is well recognized that autonomous adaptation by far outweighs planned adaptation. Planned adaptation is however consuming policy adaptation processes that rarely incorporates or build upon autonomous mechanism and hence fails to be sufficiently responsive to community needs (Bhola, 2009). In Kenya, climate change awareness is slow countrywide and this was evident from consultative forum on developing National response Strategy on climate change (NCCRS, 2010). There is need for awareness creation, targeting different tools and media such as print and electronic, drama, community forums, incorporation of climate change into Kenya's educational curricula at different level starting with primary to tertiary institutions (NCCRS, 2010).

Many UNEP divisions of environmental law and Conventions (UNEP-DELC) acknowledge that many governments and NGOs are already working actively to raise awareness on climate change. It however accept that the scale of changes required and the vast of number of people and interest that must be informed and influences call for outreach activities of a much greater magnitude.

Borrowing from the communication, Education and Public awareness programmes of the Convention on Biological Diversity (CBD), an effective public education and awareness should entail Communication; The scientific and technical work of UNFCCC, The Kyoto protocol and post Kyoto agreement documents in a language that is accessible to many different groups, Education: integrating climate change into educational systems of all parties to the convention, and Public awareness on importance of climate change and its

implication to the lives of urban and rural communities including livelihoods (NCCRS, 2010).Training of rural community for climate change refers to the development or strengthening of personal skills, expertise, relevant institutions and organization to reduce the GHG emission and/or to reduce vulnerability to climate related impact on rural livelihoods (article 9(d), UNFCCC). In view of the risk and opportunities presented by climate change, enhanced capacity building is required to strengthen capability of Kenya which have very few climate change specialist in areas of science, policy, adaptation mitigation, carbon trading and carbon markets (NCCRS, 2010).

2.5 The concept of conservation strategies

Human beings quest for riches and economic development has not come to reality with resource limitation and carrying capacity of ecosystem. This has been witnessed through limitless building and creation matched by equal power of destruction and annihilation. To address this challenges, it call for globally coordinated effort as well as concerted will of the national, regional and international governments to implement programmes that addresses the issues of climate change on livelihoods (IUCN, 1980). In native New Hampshire, intra-agency coordination and Policy is used in conservation, and protection of wildlife habitat. Long-term recovery of threatened and endangered species are achieved by focusing on protection of high quality habitat rather than focusing on an individual's (New Hampshire Action Plan, 2007)

Informal and formal institutions, agencies, adults, NGO and volunteers needs to identify conservation action that proactively restore and conserve the Natural resources so as to avert the impact of climate change in rural environment. This has been achieved in New Hampshire through field practical on conservation, Education and awareness. New Hampshire has focused on habitat restoration and management of species which have languished as a result of historically and current development or Natural processes such as succession. The initiatives have included landscaping to placing and replacement of culverts for enhanced stream flow and improved habitat passage. This has involved federal government, state and none - state organizations, private sectors and sectors and

individual land owners. Other conservational strategies used include; land protection, land owners incentives, monitoring, population management, regional coordination, local regulation and policy, and Research.

Kenya's existing forest policy dates back to 1968 and emphasizes strong governmental control. It focuses on, among other priorities, reservation of forest areas for catchment protection and timber harvesting; forest protection by strict control of fire and grazing, and by exclusion of private uses; employment through the "shamba" system for reforestation (USAID/ProMara, 2010). Conservation of Natural Resources such as forest provides water for agricultural activities, Livestock and domestic use, fuel wood, bee keeping and herbal medicine. To avert the impact of climate change among the rural livelihoods, the government of Kenya has come up with conservation policy aimed at growing 7.6 billion trees in the next 20 years. This will be implemented by growing 35,000 trees by schools, 4300 women groups, 16,350 youth groups and the six regional development authorities. This strategy also target to encourage large scale land owners with at least 50 acres to grow trees (NCCRS, 2010).

Green energy development programme seeks to exploit Kenya's abundant renewable energy. There is geothermal energy, solar energy in arid and semi-arid zones and bio-fuel from Jatropha, sugar cane and sweet sorghum which can be utilized to reduce GHG emissions and enhance conservation of forest for water catchment areas (NCCRS, 2010).

Kenya has also mobilized resources and institutions to implement REDD activities along the Mau forest, Aberdare forest and Mount Elgon water catchment areas. This is done through building capacity and strengthening REDD methodologies, financial support and training of forest depended communities (NCCRS, 2010).

While there are many reasons to make REDD work for the poor, notably the potential to enhance sustainability of REDD systems by reducing conflict over resources, there are various interpretation of what this would mean into practice. The options are; No 'harm REDD which aims to avoid increased threat to the poor and 'pro poor REDD which

actively seeks to deliver benefit to the poor. Different actors are concerned with conservations which are addressing the issues of livelihoods as well as enhancing conservation of Natural Resources (Leo et al, 2008).

2.6 The concept of Structural arrangements

To understand the role of institutions in adaptation and mitigation of climate change towards rural livelihood, especially by the poorer and more marginalized groups, it is essential to attend to historical repertoire of strategies used by rural populations (Arun, 2008). Natural resource-dependent rural households are already experiencing challenges of drought, flood, variability in rainfall, storms, ecosystem degradation, heat waves, fires, epidemics and conflict and this will only be averted if better structures are in place. The success of historically developed response strategy to the effect of climate change on rural livelihoods by the community depends crucially on the nature of prevailing formal and informal rural institutions (Arun, 2008). Rural structural arrangement can help shape and enhance response to effect of climate change in relation to climate change-induced risks and how external interventions can help strengthen the functioning of rural institutions relevant to adaptation. The structural arrangement includes public, civic, private sectors and their important work on enhancing response to effect of climate change on rural livelihoods.

Climate change is not just a matter of an environmental phenomenon but also socio-economic and political issues in the world. In Nepal, The level of understanding and awareness on the climate issue is very limited. Nepalis facing a number of challenges for achieving socio-economic and environmental development indicators and outcomes as identified in the development plan (Bhola, 2009). This has contributed to low economic strength, inadequate infrastructure, low level of social development, lack of institutional capacity and higher dependency on Natural resources as major vulnerable factors. Climate change in Nepal has impacted on rural livelihoods of Nepalis contributing to low infiltration of soil, increased incident of insect pest caused by low productivity of many crops. There have been found problems of maize wilting during cob development. This has led to income of communities decreasing thus increasing vulnerability. The efforts

are being made to mitigate the impact of climate change and increase resilience capacity of the people from different actors (government agencies and non government organizations).

A study carried out in five districts of Nepal; Bhang, Dailekb, Humla, Tanahu and Terahthum to document community perception identified issues and gaps (Bhola, 2009). Effectiveness of existing government mechanism, technical backstopping for farmers, proper distribution of technical manpower, information system in farming, demand driven analysis, strong research and extension in agriculture, positive journalism, quality inputs, and insufficient irrigation facilities were found to be major issues regarding to climate change and livelihood. In Pakistan, Climate change has caused a lot of vulnerability thus posing a threat to economic and socio-political threat. With all these challenges, this has not been incorporated into economic planning by the government of Pakistan (Farrukh, 2011). Flooding has caused displacement in Pakistan. Pakistan has subscribed to 14 major multilateral agreements environmental agreement (MEAs), UNFCCC, Biodiversity Commission and Biosafety Protocol (CP), the Desertification Convention (UNCCD), the Chemicals and Hazardous Waste Convention and the convention related to endangered species (CITEs). All these have been accompanied by legislations aimed at protecting and developing environment and Natural resources.

In Kenya, there are a number of policies governing various environmental sectors including wildlife Policy (Sessional paper number 3. Of 1975) and food policy (Sessional paper no. 3 of 1993), but these hardly recognize Climate change as a serious threat and problem. The closest Kenya ever came to developing comprehensive environmental policy was with the drafting of Paper number 6 of 1999 on Environment and development until in August 2010 when Kenyans adopted the constitution that incorporated environmental concerns (NCCRS, 2010; The Kenya's Constitution, 2010). A legal framework is the foundation for an effective policy. Being a purposeful statement by a government expressing its recognition of a problem and stating its commitment to address a problem through specified actors, and one of the key functions of the policy is

to advise and direct the government and the governed on the necessary actions to address identified problems (NCCRS, 2010).

Kenya has sectoral laws – including the Forest Act (2005), Agricultural Act (cap 318 of Kenyan Laws) - which address various aspect of climate change. In addition, there is a comprehensive Environmental Law – the Environmental Management and coordination Act (EMCA, 1999) – which has relevant provisions for mitigation against climate change. However the EMCA 1999 does not effectively address climate change issues such as developing inventories on anthropogenic emission of GHG, National framework for carbon finance, Development of National and regional programmes to mitigate climate change by addressing anthropogenic emissions by sources, training and awareness and access to environmentally -sound technology (NCCRS, 2010).

2.7 Theoretical Framework

Kenya acknowledges that the change in the Earth's climate and its adverse effect are common concern to humankind. The Ministry of Environment and Mineral resources (MEMR) has therefore recognized the need to enhance coordination of climate change activities in the country with view of ensuring climate-proof socio-economic development anchored on low carbon path (NCCRS, 2010). According to Blast (2010), climate change is as a result of human emission of green house gases such as Carbon dioxide (CO_2), methane, and Nitrous oxide which causes catastrophic rise in the global temperatures. Energy from sun reaches earth and travel through the space. Earth's atmosphere is mostly transparent to the incoming sunlight, allowing it to reach the planet surface where some of it is absorbed and some is reflected back as heat to the atmosphere.

Water Vapour is a major cause of green house gases (36-90% of green house gas effect (Blast, 2010). Earth's climate also responds to several other types of external influences such as variation in the solar radiation and in the planets orbit. These influences are directly caused by emission of man-made green house gases but in small quantity. According to Blast (2010), the proponent of anthropogenic global warming theory postulates that man-made CO_2 is responsible for floods, droughts, severe weather, crop

failure, species extinctions, and spread of diseases, oceanic coral bleaching, famine and literally hundreds of other catastrophes. All these disasters will become more frequent and more severe as temperatures continue to rise, they say. Nothing less than large and rapid reduction in human emission will save the planet from these catastrophic events.

In the concept of mitigation strategies, the government of Kenya through its National Climate Change Response Strategy has recommended procedures in which have been put into action plan. The strategy is complementary and consistent with existing development and economic plans, principally the vision, 2030. These recommendations will be supported by well-defined implementation, monitoring and evaluation framework. Some specific adaptation action includes;-

1. Producing and promoting of drought tolerant, diseases and pest resistant crops as well as early maturing varieties.
2. Promoting orphan crops e. g Sorghum, cassava, pigeon pea and sweet potatoes.
3. Promoting agricultural produce, post harvest-processing, storage and value addition.
4. Breeding of animals from various agro-ecological zones which adapt well to climate variations.
5. Providing special insurance schemes to spread and transfer risks from the climate change.

In addition Kenya stands to benefit from Carbon Market by putting in place mitigation measures including the promotion of energy efficiency and renewable energy technologies, for instance solar, geothermal, biomass and small hydro-plants (NCCRS, 2010).

In the concept of training and awareness, Kenya has put in place some of the climate change awareness campaign through;-

1. Print and electronic media to put across climate change information in various articles and programmes on climate change.
2. Incorporating climate change into schools and college curricula and syllabuses.

3. Eco-tournament engaging in sporting events such as athletics, football and basket ball to raise awareness.
4. Encouraging individual volunteers in raising awareness.
5. Involving corporate sectors, especially in mobile phone industry to display ‘airtime top-up messages on climate change.

Training and awareness will enhance the adoption of climate-change adapted resource management practices such as planting of early maturing crops, adoption of hardy varieties of livestock and selective keeping of livestock in areas where rainfall had declined (Olofunso, 2010). This will also increase the use of technological products that enable individuals to function in the ‘new’ condition. Obviously, adaptation strategies are required to be many and their combination in various ways will be required in any given location (Nyong et al, 2007). Adaptive capacity is essential to resilience. It is the capacity of renewal and reorganization, and the element of learning in response to disturbance (Folke, 2006).

2.8 Conceptual Framework

A conceptual framework is when a researcher conceptualizes the relationship between the variables in the study and shows the relationship graphically or diagrammatically. It is a hypothesized model identifying the concepts under study and their relationship (Mugenda and Mugenda, 1999)

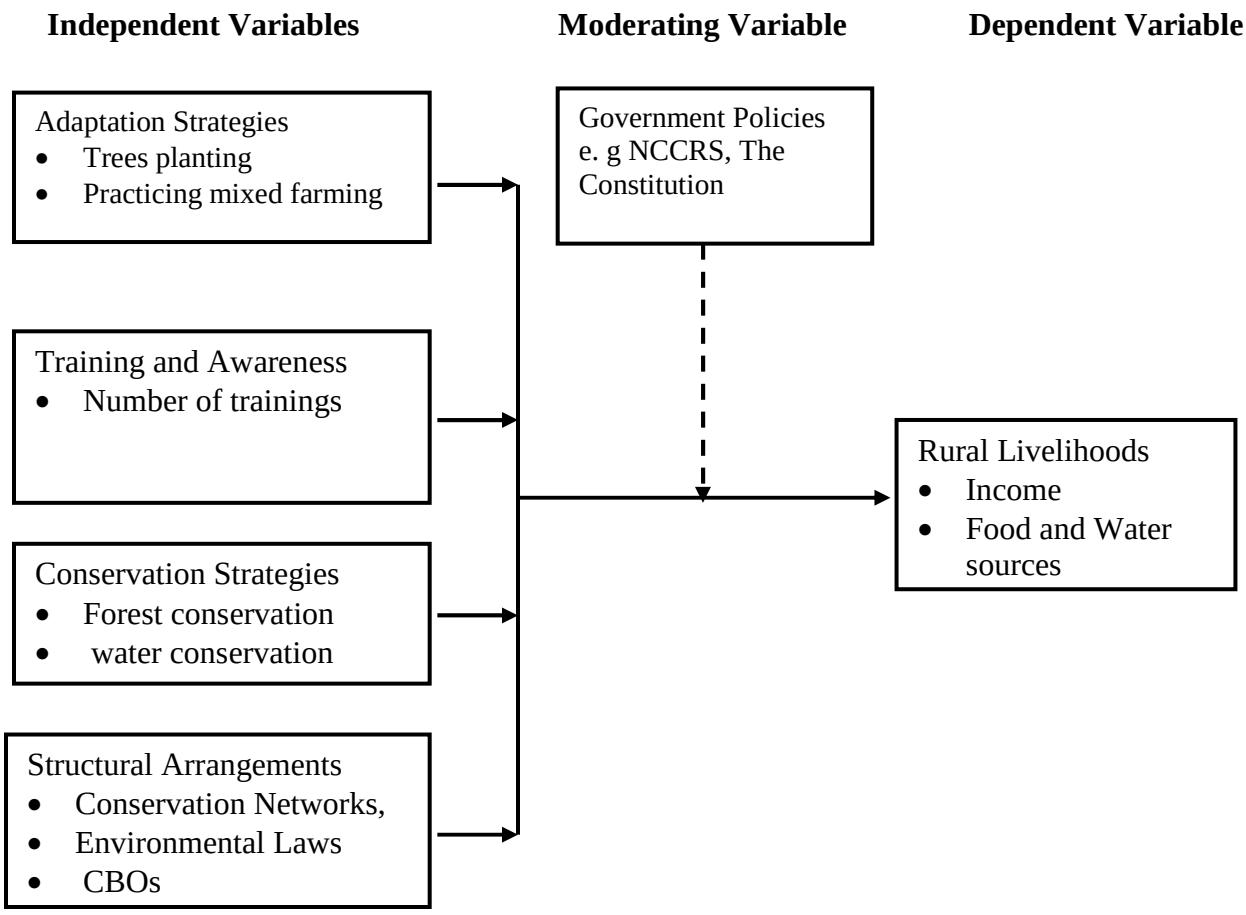

Figure 1: conceptual frame work

In this study, rural livelihood is dependent variable. Measures of whether climate Change Mitigation strategies (independent variable) influences rural livelihood (dependant) rely on factors such as adaptation strategies, training and awareness, conservation strategies and structural arrangements within community of Kuresoi district to cope with those effects. The moderating Variable in this study is government policies which are very crucial to community members of Kuresoi district for putting in place measures to avert the issues of climate change.

2.9 Knowledge Gap

It is universally accepted that climate change is one of the great challenges facing humanity in this century (Olofunso, 2010). In Kenya, this phenomenon is already unmistakable and intensifying at an alarming rate as is evident from country wide temperature increases and rainfall irregularity and intensification (NCCRS, 2010). In its fourth assessment Report, the IPCC projects that without further action to reduce greenhouse gas emissions, the global surface temperature is likely to rise by a further 1.8^{o}C to 4.0^{o}C. Even the lower end of this range would take the temperature increase since pre-industrial times above 2^{o}C, the threshold beyond which is irreversible and possibly catastrophic changes become far more likely (Olofunso, 2010).

The world's less industrialized regions are particularly vulnerable to the effect of climate change. In rural areas, specifically, environment change has immediate and direct effect on health and well-being of millions of households that depends on natural resources for their basic households. When weather changes reduce families' livelihood options, these changes can act as 'push factors': people leave resources-dependent rural areas and create new migration patterns. Because migration represents tremendous force of social change, the potential for climate change to increase migration deserves careful consideration and policy attention and which at the same time receives no or little consideration by the governments and community leaders (Hunter, 2008). A link between migration and climate factors such as temperature and precipitation has been documented in several rural areas of developing nations. For instance in Bukina Faso, residents of dry rural areas are likely to migrate to rural regions with greater rainfall. In this way migration may be a long term response to the threat of recurrent droughts. Still, only short-distance moves appear affected by climatic factors, since international migration tends to be less common in a period of rainfall shortage, perhaps because of the investment required for an international move.

Although climatic change is occurring and will continue, governments have taken little policy action actions to reduce climate-related migration strategies, particularly in rural regions of less developed countries. Such policies need not to be climate-specific, but

could serve to enhance families' livelihoods options, making them more resilient if their resource-base changes. In this way, development efforts and programs to reduce poverty will lessen livelihood vulnerability, ultimately reducing the need for families to migrate because of climatic changes. According to NCCRS (2010), an analysis of existing environmental policy and legal framework has revealed that Kenya currently has no policies that deal directly and explicitly with climate change. The only policy that has attempted to address climate change to some extend is the draft National Environmental policy and the related legislation be put in place by either reviewing and updating clause on climate change in the draft National Environmental Policy or developing a completely new climate change policy. While the Kenya's constitution Promulgated in August 2010 gives provision on environmental sustainable environmental and Natural resources management, this may or is experiencing challenges of factors such as socio-economic activities of the poor rural communities, political interference and even protracting conflict in the areas where conservation activities are taking place. Existing laws such as EMCA is not climate responsive and the government has not put in place new and comprehensive climate change law. NCCRS (2010) recommended that a new legislation be enacted, a process that could run concurrently with policy formulation.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter outlines the methodology used in the study. This includes research design, target population, sample and sampling procedures, description of research instruments, validity and reliability of instruments, data collection methods and data analysis procedures.

3.2 Research Design

This study utilized both qualitative and quantitative approaches and used statistical analysis to describe and infer the relationship between the dependent Variable and independent variables. The researcher delineates that adaptations strategies, training and awareness, conservation strategies and structural arrangement are the main contributor to rural livelihoods while the moderating variable factors are government policies. The quantitative research approach aimed at determining the relationship between the independent variables and dependent variables in a population. Quantitative research design used was descriptive survey which establishes the relationship between climate change mitigation strategies and rural livelihoods. It involved sampling and generalization.

3.3 Target Population

The target population comprised community based organizations (CBOs), Kenya Forest service and community representatives of Kuresoi district. Since 2007, there are twenty five Community Based Organizations and Kenya forest services officials implementing climate change response at grass root level in Kuresoi district. Each community based organization has seven management committee representatives. The CBO committee is made of three executive members, government representatives (chief or assistant chief or KFS official) and three non executives who are community members. In total, the population size for the 25 CBOs is 175 members across the four divisions of Kuresoi district.

3.4 Sampling Procedure and Sample size

Frankel and Wallen (2000) defines sample as any part of a population of individuals on whom information will be obtained in a research study. They define sampling as the process of selecting individuals who will participate in research study.

The sampling frame used is the Community Based Organization (CBO) structure. The sampling design used to draw the sample size required was stratified sampling design which stratifies the sampling frame into three strata namely; The CBO executive is made up of the Chairperson, Treasurer and secretary; CBO government representatives who are chiefs, assistant chief and KFS official and finally; the CBO non-executives who are community members. When population is more than 10,000 individuals, 384 of them are recommended as the desired sample size (Mugenda and Mugenda, 1999). The accessible population in this study was 175.

Mugenda and Mugenda recommend the formula:

$$nf = \frac{n}{1 + n/N}$$ to be used to calculate the samples size.

According to the above formula:

nf= desired sample size when population is less than 10,000,

n= desired sample when population is more than 10,000,

N= Estimate of the population size

$$nf = \frac{384}{1+384/175} = 120 \text{ respondents}$$

120 individuals were therefore sampled to participate in this research.

3.5 Data Collection Instruments

Frankel and Wallen (2000) defined research instruments as the device the researcher uses to collect data. Both primary and secondary sources of data were used for this study. Data was collected by administering the questionnaires to the respondents in Kuresoi district community members to avert the impact of climate change.

Questionnaires used ensured anonymity and allowed use of standardized questions with time provided for subjects to think about responses. Two sets of questionnaires were used for data collection with one set administered to community members' representatives, second set to CBOs and KFS.

3.6 Validity of the Research Instruments

Frankel and Wallen (2000) defined validity as the extent to which a research instrument measures what it is intended to measure. Validity deals with the accuracy of a test or a research instrument. For the study, the researcher took two precautions to ensure validity of the instruments; firstly, the researcher submitted the draft instruments to the supervisor to check the validity and give input. There was a review of the existing secondary data on environmental issues and conservation strategies in Kuresoi district which ensured that instruments tested what they were expected to test. This measure showed the need for modification or adjustments of the instruments before actual data collection.

3.7 Reliability of the research instruments

Ogula (1998) defines reliability as the extent to which a research instrument yields measures that are consisted each time it is administered to the same individuals. Mugenda and Mugenda also states that if a researcher administers a test to a subject twice and gets the same score on the second administration as the first test, then there is high reliability for the instrument used. To ensure reliability, the researcher administered ten questionnaires to ten representatives of CBO at Molo District. The results of the pilot study were discussed with respondents as well as with the supervisor to make the required adjustment. The Major Objective was to test reliability.

3.8 Data Collection Procedure

The letter of request to conduct research was sent to the University of Nairobi, Extra-Mural Centre Studies, Nakuru Campus. A letter of introduction to collect data was obtained and official authorization from the Office of the president through Kuresoi District Commissioner was also obtained prior to the administering the questionnaires to

the respondents. The questionnaires for CBOs together with the letter from the University of Nairobi were dropped to respective locations. The researcher together with his research assistants followed up on the progress of the collection of questionnaires by walking around. The researcher also met with CBOs members personally to explain to them about the quality of data required for study and empathized to them to complete filling the questionnaires.

3.9 Data Analysis Techniques

According to Cohen and Marion (1994), once the data is collected, editing should be done to identify and eliminate errors. Data analysis is the breaking down of large components of research data or information into simpler, easily synthesized and understood parts. In this study, the researcher de-synthesized data to answer the research questions. After data collection, raw data was sorted out and edited to identify blank spaces or unfilled items, and those that had been erroneously responded to. The researcher organized data into categories according to research questions and establish expected theme categories for qualitative data. The data was cleaned, coded and entered into the computer for analysis. Data was then analyzed using statistical package for social scientists computer software. This was then summarized and presented using tables. Qualitative data derived from open-ended questions in the questionnaire and interview guides was organized according to the themes and research questions or objectives.

3.10 Ethical Considerations

The researcher received a letter of introduction from the University of Nairobi and a research permit from the District Commissioner for Kuresoi before actual data collection. On arrival to Kuresoi, the researcher had a meeting with identified research assistant who were familiar with Kuresoi district for familiarization with the research area. Appointments with key respondent were made before questionnaires were administered. During questionnaire administration, the respondents were reminded that this research was purely for academic purpose.

3.11 Operational definition of Variables

Table 3.1 Operationalization of Variables

Objectives	Variables	Indicators	Tools of analysis	Types of analysis
	Independent			
To determine how adaptation strategies mitigates effects of climate on rural livelihoods	Adaptation strategies	Practicing mixed farming	Frequency and percentages	Descriptive, Inferential Statistics
To examine how training and awareness mitigates effect of climate change on rural livelihoods	Training and awareness	Number of trainings conducted.	Frequency, percentages and cross tabulation	Inferential Descriptive, statistics
To examine how conservation strategies influences effect of climate change on rural livelihoods	Conservation Strategies (protected areas/ controlled logging	Forest Conservation and water Conservation	Frequency and percentages	Inferential Descriptive statistics
To analyze how structural arrangement influences effect of climate change on rural livelihoods	Structural arrangement (existing laws and climate change advocacy groups)	Conservation Networks, Environmental Laws community based organizations	Frequency and percentages	Inferential Descriptive, statistics
	Dependent			
	Rural Livelihoods	Income Adequate food Adequate water	Frequency and percentages	Inferential Descriptive statistics

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.1 Introduction

This chapter focuses on the presentation of analysis and interpretation of the results. Primary data collected from respondents in Kuresoi district was analyzed in order to find out the influence of climate change mitigation strategies on rural livelihoods. Descriptive statistics such as frequencies and percentages were used to analyze responses to various variables in the questionnaires.

4.2 Response Rate

A total of 120 people were issued with questionnaires and 108 respondents returned the questionnaire. A response rate of 90% was obtained in the study and this is a good response rate according to Mugenda and Mugenda (1999).

4.3 Results on social factors on respondents

The research data was gathered from a total of 25 different organizations from 33 locations within Kuresoi district. Most of the respondents 104 (96%) came from youth village organizations mostly referred to as *youth Village Bunges* structured and supported by Mercy Corps and USAID/ProMara. All respondents served in leadership positions that included 19 (18%) chairpersons, community chiefs 15 (13%) and secretaries and treasurers 13 (12%) each. Other leadership positions included village elders, youth representatives and church leaders. The 4 (4%) forest officers interviewed were from either Kenya Forest Service or Community Forest Association. Gender representation among the total 108 people interviewed was a bit skewed to men being more with 70 (65%) compared to their female counterparts 33 (31%). This study found most respondents falling in 21 – 30 years of age bracket recording 42% of the total 108 reached respondents. This was followed by those that came from 41 – 50 years who recorded a 23. These finding can be attributed to the fact that most organizations visited were mostly youthful and found at the village level. Table 4.1 gives more information on other age groups.

Table 4.1. Respondents' representation by age

Age level	Frequency	Percentages
Below 20 years	15	14
21-30 years	45	42
31-40 years	17	16
41-50 years	25	23
Above 50 years	6	5
Total	**108**	**100**

Considering education levels, only 6 (6%) of the total interviewed from Kuresoi had not completed primary school education. 10 (9%) statistics was registered for those with university education. A majority of the respondents 64 (59%) had secondary school education which is basic enough to understand climate change management and effects. The total respondents reached were 108 people and Table 4.2 illustrates respondents' education level findings.

Table 4.2 Education levels of respondents

Age group	Frequency	Percentages
Primary level incomplete	6	6
Primary level completed	14	13
Secondary level incomplete	14	13
Secondary level completed	64	59
University completed	10	9
Total	**108**	**100**

4.4 Adaptation as a Climate Change mitigating strategy on rural livelihoods

This study present several frequency tables and cross tabulations analysis together with basic empirical statistics on different biographical variables and the effects or influences of adaptation or mitigation strategies on climate change for rural livelihoods in Kuresoi district.

4.4.1 Determining influence of adaptations strategies on rural livelihoods

The study had gender, age, education level, type of organization and location of organization forming the background and biographical variables on which research objectives were analyzed for better understanding.

One of the initial questions asked during data collection sort to find out if there exist ways in which organizations in Kuresoi district are involved in identifying adaptation strategies to address the effect of climate change. The response to this question gave a positive answer with a majority respondents 89 (82%) acknowledging they do have ways in which their organizations are involved in identifying adaptation strategies to help address effects of climate change. Only 19 (18%) out of the total 108 respondents had a "no" response to the question. These demonstrate how sensitive organizations in Kuresoi district are when it comes to the climate change effects.

The research established that different adaptation strategies are encouraged by different organizations in Kuresoi district. The feedback from most respondents pointed at change of crop patterns as the highest rated strategy to mitigating climate change effect with 25 (23%) of the respondents. This was followed by a combination of change of crops patterns, cross breeding of livestock to make them hardy to climatic changes and adoption of renewable sources of energy. Other strategies mentioned include change of eating habits/food presence. However, 5 (5%) of the people were not sure of any strategy they were encouraging in the area.

4.4.2 Community and adaptation strategies mitigation effects on climate change

In acknowledgement that most people in Kuresoi district are encouraging different kinds of adaptation strategies to mitigate on the effects of climate change, involvement of the community members in identifying such strategies was a concern for this research. When respondents' feedback was analyzed, the results showed a great involvement by the community to identify adaptation strategies used in different locations. This fell to a high of 86 (80%) in support of community involvement as opposed to 22 (20%) of total respondents who thought there was no community involvement as shown in Table 4.3.

Table 4.3 Community involvement in identifying adaptation strategies in their location

Response	Frequency	Percentage
Yes	86	80
No	22	20
Total	**108**	**100**

Further to the above, it seemed clear that other members of the community are currently applying adaptation strategies as mentioned by the majority of the respondents. 76 (70%) of the respondents accepted that they were aware of someone in their location who at that point applied some adoption strategies compared to 31 (29%) who said they were not. The adoptive strategies in this case ranged from change of crop patterns, cross breeding of livestock, adoption of renewable sources of energy and change of eating habit. This is illustrated in Table 4.4. There was strong evidence through the respondents that communities in Kuresoi pay a lot of attention to adoptive strategies and had made this a priority to address the effects of climate change on livelihoods. A majority 85 (79%) of the respondents responded with a 'yes' when asked if it was apriority of the community to adapt to strategies in order to address the effect of climate change compared to those who said 'no'; 23 (21%). This positive feedback can be attributed to the community seeing importance of conservation of Mau Forest that is the main water tower for Kuresoi district not to mention the intensive public attention to it by the media.

Table 4.4 Response on community members currently applying adaptation strategies

Response	Frequency	Percentage
Yes	76	70
No	31	29
Missing	1	1
Total	**108**	**100**

4.4.3 Funding for mitigation of climate change effect

According to most respondents interviewed, 63 (58%), government and Non-governmental organization have reasonably given attention to funding to respond to climate change effects. There is however a good number, 45 (42%) who reported absence of funding from governments and NGOs. This is illustrated in Table 4.5.

Table 4.5 Availability of both government and NGO funding

Funding by government or NGO	**Frequency**	**Percentage**
Yes	63	58
No	45	42
Total	**108**	**100**

Climate change effects have drawn attentions of both the government of Kenya and NGOs. For this reason, funding for interventions that point at mitigation of climate change effects are evident in Kuresoi district at least at the time of data collection. Table 4.6 below provides descriptive evidence of how money towards climatic change intervention is provided to communities in Kuresoi. From the table, funding to the community is mostly through community based organizations 50 (46%); a finding that perhaps tells how the government and NGOs are convinced with grass root mitigation strategies to climatic change effects. Such organizations include youth self help groups and women groups. Financial support through key government departments came second with a frequency of 36 respondents (33%). 12 people (11%) were not aware of any way of funding for climatic change interventions while other 3 (3%) did not respond to the question.

Table 4.6 How funding towards climatic change is provided to the community

Ways of funding	Frequency	Percentage
Through community based organization	50	46
Government key departments	36	33
Location committee	3	3
Individuals households	4	4
Don't know	12	11
Missing	3	3
Total	**108**	**100**

4.5 Training and Awareness as a Climate Change Mitigation Strategy on rural livelihoods

Training and community awareness of mitigation effects of climate change patterns or just the climate change patterns on rural livelihoods may help communities effectively manage the effects of climate change. Most aspects of training and awareness in this respect would include general knowledge and monitoring of climate change patterns, climate change advocacy and community participation.

4.5.1 Community awareness of climate change patterns

Climate change stakeholders will agree that awareness on the effects of climate change is the first step to developing a mitigation strategy. Most respondents 95 (88%) compared to the few 13 (12%) accepted the opinion that most community members are aware of the climatic changes taking place and that their livelihood problems were as a result of such climatic challenges with a 98 (91%) responses rating. Climate change discussions at the community level seem to be the best way through which communities monitor, keep track of and understand climate change communication. The data provided showed evidence as presented by 32 out of the possible 108 respondents (30%) being for the opinion that neighbours discussed climate change issues. This was followed by information by government administrators that included Chiefs and Sub-Chiefs through Chief Barazas with 27 (25%). Kenya Forest Service reports came third with 22 (20%) of the people surveyed backing it up. Table 4.7 has a summary of the results.

Table 4.7 How the community monitors climate change communication in the area

Climate change monitoring method	Frequency	Percentage
Neighbors discuss climate change issues	32	30
CBO reports	8	7
NGO meetings	3	3
Kenya Forestry service reports	22	20
Feedback during meetings	9	8
Government administrators (Chief and sub-chief) barazas	27	25
Missing	7	7
Total	**108**	**100**

4.5.2 Community training on climate change patterns

Training is a process of building one skills and knowledge to be able to understand well the subject. This process can be short term or long term depending on the arrangement in place, objectives of the training and what content to be covered. This study had a question to establish if the respondents had undertaken any training or forum on climate change issues. As illustrated in Table 4.8, there was a close frequency between those who had attended trainings on climate change and those who had not. Specifically, those who had training were 62 or 57% of the total respondents compared to those who had not; 44 (41%).

Table 4.8 Attendance of training or forum on climate change issues

Training	Frequency	Percentage
Yes	62	57
No	44	41
Missing	2	2
Total	**108**	**100**

To have further insight on training attendance patterns against level of education, a cross tabulation of whether training had been attended against level of education variables was

conducted and results presented as in Table 4.9. From the results, there were more numbers who had attended climate change training and forums for those respondents who had completed their secondary education and above compared to those with incomplete secondary level education and below who had training. Similarly, those who had less education of secondary level incomplete and below and who had not had training were more compared to those less educated (secondary level incomplete and below) counterparts who had training.

Table 4.9 Training/forum attendance on climate change issues against education levels

	Education Levels					
Attended training	**Primary level incomplete**	**Primary level completed**	**Secondary level incomplete**	**Secondary level completed**	**University completed**	**Total**
Yes	2 (3%)	7 (11%)	6 (10%)	41 (66%)	6 (10%)	62 (100%)
No	4 (9%)	7 (16%)	8 (18%)	21 (48%)	4 (9%)	44 (100%)
Missing	0 (0%)	0 (0%)	0 (0%)	2 (100%)	0 (0%)	2 (100%)
Total	**6 (6%)**	**14 (13%)**	**14 (13%)**	**64 (59%)**	**10 (9%)**	**108 (100%)**

The levels of satisfaction from the trainings or forums given were also measured across three levels. These levels were: satisfied, fairly satisfied and dissatisfied. Overall, most respondents were fairly satisfied and satisfied cross all training indicators except on the 'accountability of CDF duty bearers to the community' indicator which had 54 (50%) of respondents dissatisfied. It is also good to notice a higher level of dissatisfaction 44 (41%) recorded on the relevance of the trainings or topics discussed during the forums. Respondents' feedback is summarized in Table 4.10;

Table 4.10 Levels of satisfaction across different training indicators

Training Indicator	Satisfied	Fairly satisfied	Dissatisfied	Missing	Total
Training/forum location	26 (24%)	42 (39%)	30 (28%)	10 (9%)	108 (100%)
Community participation in identifying training areas	15 (14%)	58 (54%)	25 (23%)	10 (9%)	108 (100%)
Relevance of the trainings or topics discussed	21 (19%)	31 (29%)	44 (41%)	12 (11%)	108 (100%)
Quality of trainings	14 (13%)	37 (34%)	31 (29%)	26 (24%)	108 (100%)
Number of trainings	7 (7%)	38 (35%)	42 (39%)	21 (19%)	108 (100%)
Training on climate change effect mitigation	7 (6%)	41 (38%)	41 (38%)	19 (18%)	108 (100%)
Accountability of CDF duty bearers to the community	10 (9%)	28 (26%)	54 (50%)	16 (15%)	108 (100%)
Overall impact of awareness	10 (9%)	48 (44%)	33 (31%)	17 (16%)	108 (100%)

4.6 Conservation as a Climate Change Mitigation Strategy on rural livelihoods

It was in the interest of the researcher through this study to measure satisfaction levels on environment conservation activities or strategies taking place within Kuresoi district. Indicators that were used included tree planting initiatives, existence or establishment of protected areas, and agro-forestry promotion.

Tree planting as an environment conservation strategy led with over 90% in satisfied and fairly satisfied scales combined. This is shown in Table 4.11.

Table 4.11 Levels of satisfaction across different environment conservation activities

Conservation strategy	Satisfied	Fairly satisfied	Dissatisfied	Missing	Total
Tree planting in Mau forest	28 (26%)	63 (58%)	14 (13%)	3 (3%)	108 (100%)
Establishment of protected areas	20 (19%)	50 (46%)	34 (32%)	4 (4%)	108 (100%)
Tree planting in schools and other public places	36 (33%)	52 (48%)	16 (15%)	4 (4%)	108 (100%)
Agro forestry promotion	28 (26%)	51 (47%)	24 (22%)	5 (5%)	108 (100%)

Conservation strategies in Kuresoi district have a direct impact on mitigating the effect of climate change as reported by 87 (81%) of the respondents; Table 4.12. Similarities in views of the respondents about how the conservation strategies had impact in mitigating the effect of climate change on rural livelihoods were evident from the findings. The main theme found included environment conservation being important as the main source of life for all living things. Specific positive effects of conservation strategies included wild life and soil erosion protection and support for agriculture and food security.

Table .4.12 Conservation strategies impact on mitigating the effect of climate change

Conservation strategy impact	**Frequency**	**Percentages**
Yes	87	81
No	13	12
Missing	8	7
Total	**108**	**100**

4. 7 Structural Arrangements as a climate change mitigation strategy for rural livelihoods

Government and institutions have focused their efforts in putting in place measures to mitigate against climate change effects in different ways. In Kuresoi district for example, institutions and policies that point at mitigating effects of climate change on rural livelihoods exist but with different levels of efficiency and effectiveness. Community members from the district were asked to rate their level of satisfaction with the existing institutions and policies on mitigating the effect of climate change. The data showed poor use of budget as a tool for fund allocation with 60 respondents (56%) expressing dissatisfaction. This was followed by a 55 (51%) of the respondents saying they are dissatisfied with the existence of legitimacy in application of policies by the institutions. Many people in Kuresoi have understanding of available policies or institutions; over 28 (26%) and 51 (47%) registering satisfied and fairly satisfied level of response. Community involvement in policy formulation and implementation did satisfy and fairly satisfy the people in the community as well as shown in the Table 4.13.

Table 4.13 Structural arrangements impact on mitigating the effect of climate change

Availability of Institutions and policies	Satisfied	Fairly satisfied	Dissatisfied	Missing	Total
Understanding of available policies or institutions	28 (26%)	51 (47%)	26 (24%)	3 (3%)	108 (100%)
Legitimacy in application of policies by the institutions	15 (14%)	35 (32%)	55 (51%)	3 (3%)	108 (100%)
Community involved in policy formulation and implementation	14 (13%)	48 (44%)	39 (36%)	7 (7%)	108 (100%)
Mitigation activities carried out by the government, NGOs, KFS or CBOs	11 (10%)	47 (44%)	43 (40%)	7 (6%)	108 (100%)
Use of budget as a tool for fund allocation	9 (8%)	30 (28%)	60 (56%)	9 (8%)	108 (100%)

4.7.1 Challenges faced in responding to the effects of climate change

There exist many challenges in trying to respond to the effects of climate change. This fact was acknowledged by a majority respondents; 97 (90%) compared to those who thought there were no challenges; 5 (5%). The major challenge mentioned was political interference with 29 (27%) feedback as shown in Table 4.14

Table 4.14 Challenges faced in responding to effect of climate change

Challenges	Frequency	Percentage
Political interests	29	27
Increased conflict	11	10
Lack of support from the local leaders	19	18
Lack of commitment by the community	18	17
Inadequate resources	19	18
Policy gaps	5	5
Missing	7	6
Total	**108**	**100**

CHAPTER FIVE

SUMMARY OF FINDINGS, DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary of findings, discussion, conclusions and recommendation from the study and areas for further research.

5.2 Summary of findings

Summary of findings are given in Table 5.1.

Table 5.1 Summary of the findings

Objectives	Main Findings
To determine how adaptations as a climate change mitigation strategy influences rural livelihoods	89(82%) respondents are involved in identifying adaptation strategies. Mixed farming and change of crop pattern was the highest with 25(23%) respondents.
To examine how training and awareness as a climate changes mitigation strategy influences rural livelihoods	62 (57%) of respondents had participated in the training. 26(24%) of those trained were satisfied with the locations of trainings while 21(19%) were satisfied with the relevance of the trainings. 30 (28%) were not satisfied with the training location while 44(41%) were also not satisfied with the relevance of the training.
To examine how conservation as a climate changes mitigation strategy influences rural livelihoods	87(81%) respondents reported that Conservation strategies had direct impact to their livelihoods. Tree planning in schools reported by 36(33%) respondents as the most preferred conservation of Water Catchment areas. Planting of tree in Mau forest and agro forestry both came second with 28(26%) respondents
To analyze how structural arrangements as a climate change mitigation strategy influences rural livelihoods	55 (51%) of respondent are not satisfied by legitimacy of existing policies whereas 51 (47%) fairly satisfied in the understanding of those policies and institutions. 48(44%) are fairly satisfied in community involvement of policy formulation while 43(%) not being satisfied by activities carried out by CBO and 60(56%) not satisfied by budget allocation for Climate change response in Kuresoi District.

5.3 Discussion.

A discussion of the findings is presented below.

5.3.1 Demographic information analysis

A total of 108 respondents most of them in local organizations leadership positions that included chairpersons, treasurers, secretaries, chiefs, Kenya forest officers among others were interviewed for this research. 104 (96%) respondents were youth village Community based organizations and 45 (42%) of age bracket 21-30 being the majority of those interviewed. This is in agreement with the finding that Kuresoi district population is largely youth full population with 74.4% of the population being less than 30yrs whose livelihoods heavily rely on natural resources such as forest (Kuresoi Analysis Report, 2009)

5.3.2 Adaptation strategies and climate change mitigation effects

The study shows that community members of Kuresoi district are involved in identifying adaptation strategies to help address the effect of climate change effects on their livelihood which include farming, grazing, water resource management and forest timber management.

The researcher also established that different adaptation strategies are encouraged by different organizations in Kuresoi district. These included Change of crop patterns being highest with 25(23%) respondents. The other strategies included rotational planting, switching of planning dates, adoption of hardy variety of crops, mixed farming; avoid excessive use of chemical fertilizer, use of organic manure and intercropping. This concurs with the study carried out by a Abramovitz et al, (2006) which found that measures of climate change adaptation to agriculture changes during stress and this include; changes in location of cultivations, substitution by new crops, and crop diversification.

Finally, the study further revealed that government and NGOs have only given 58% attention to climate change adaptation strategies. This measured in respect to availability of funding to adaptation strategies being carried out with most of the funding being

channeled d through community based organizations in the communities at Kuresoi district.

5.3.3 Training and awareness as a mitigation to effects of climate change

In the study 62(57%) respondents confirmed to have attended the trainings and awareness forums on climate change. A cross tabulation of training with level of education revealed that more illiterate (secondary level incomplete and below) people did not have training in climatic change effects compared to those illiterate but with training, more literate (beyond secondary level complete) people had been trained compared to those educated beyond secondary level complete but not trained.

Another finding was that there is a higher level of dissatisfaction whereby 44 (41%) respondents recorded dissatisfaction with relevance of the trainings or topics discussed during the forums. This means that contents covered during these trainings did not meet expectation of the participants. This is in contrary to the borrowing from the communication, Education and Public awareness programmes of the Convention on Biological Diversity (CBD), where an effective public education and awareness should entail Communication; The scientific and technical work of UNFCCC, The Kyoto protocol and post Kyoto agreement documents in a language that is accessible to many different groups, Education: integrating climate change into educational systems of all parties to the convention, and Public awareness on importance of climate change and its implication to the lives of urban and rural communities including livelihoods (NCCRS, 2010).

Finally, the study shows that community members are already discussing climate change issues at grassroots level with majority of respond mentioning that these discussions are discussed by neighbors while some discussions are also held at Chief's Baraza. This shows the level of interest the community members of Kuresoi have invested in monitoring and sharing information on climate change.

5.2.4 Conservation strategies as a mitigation to effects of climate change

The Study revealed that conservation strategies as a climate change mitigation strategy have influence rural livelihoods of Kuresoi district community with 81% of respondents reporting that it has positive impact in mitigating effect on Climate change.

The study shows that Majority of the Kuresoi district community members are involved in planting trees in schools and other public places. Planting of trees is highly acknowledged as a means of enhancing water catchment capacity.

As established by this research, and on combining both those with a satisfied and fairly satisfied response, tree planting in Mau forest as an environment conservation strategy was rated higher by over 80% of the respondents. It was followed by agro forestry promotion and tree planting in schools and other public places.

5.3.5 Structural arrangements as a mitigation strategy to effects of climate change

Poor use of budget as a tool for fund allocation had 60 respondents (56%) expressing dissatisfaction. This was followed by a 55 (51%) of the respondents who were dissatisfied with the existence of legitimacy in application of policies by the institutions. Many people in Kuresoi over 28 (26%) and 51 (47%); were at satisfied and fairly satisfied level of response on understanding of available policies or institutions. A majority respondents; 97 (90%) thought there exist challenges in responding to the effect of climate change on rural livelihoods. The major challenge mentioned was political interference with 29 (27%) feedback.

5.4 Conclusions

The following conclusions were made from the study. Based on the research findings, community members of Kuresoi have adaptation strategies identified change of crop patterns as the main adaption strategy in responding to the effect of climate change. Other adaptation strategies adopted includes; cross breeding of livestock to make them hardy to climatic changes, mixed cropping, inter cropping, adoption of hardy variety of crops, adaptation of renewable sources of energy and change of eating habit or food preference. According to Arun (2008), climate change is likely to manifest around increased risk to rural livelihoods. Basic Household copying and adaptation strategies put in the context of livelihoods risks can correspondent to diversification and communal pooling.

The researcher concluded that Kuresoi District Community are aware of the climatic changes taking place in their locality and have taken steps to discuss climate change issues within their neighborhood, through local leadership Chief Barazas and reports by

environment stakeholders like Kenya forest services. Though a number of community members have training in climate change issues, a sizeable number close to a half of the people need to be trained. Most respondents were satisfied and fairly satisfied across all training forum indicators.

It was also concluded that tree planting is the most common environment conservation strategy whose effect plays a great role in mitigation climate change problems. Local communities in Kuresoi district have embraced this method in different ways. They have taken initiative to plant trees in Mau Forest, schools and other public spaces with support from different stakeholders. They also promote agro forestry in their own local ways. Conservation strategies have impacted positively to mitigating the effect of climate change and in the long run improved community livelihoods.

Finally, it was concluded that there is a feeling of dissatisfaction in Kuresoi district community on the legitimacy in application of policies and use of budget as a tool for fund allocation. There is little involvement of community members by the government in formulation and implementation of Climate response policies.

5.4 Recommendations

The following recommendations were made from the study in order to improve influence of Climate Change mitigation strategies on rural livelihoods of Kuresoi District Community.

1. It is recommended scaling up and diversifying funding allocations for Climate Change response by both government and NGOs from the current 58% to over 80% in Kuresoi district. This will ensure vibrant climate that climate change response activities that are at the same time enhancing rural livelihoods. Channeling of funds through grass root organizations like youth groups and women organizations will provide support of most preferred local adaptation strategies like change in crop patterns, agro-forestry and cross breeding of livestock.
2. It is recommended that support to local approaches like community discussions through chief Barazas and neighbors as this will help create awareness among

community members. Community level tailor-made trainings on climate change issues and climate change reports and information from organizations with the mandate to manage the environment like Kenya Forest Service need to be disseminated at the local level. Community members with incomplete secondary education and below should be targeted and motivated to participate in climate change trainings which should take into account relevant climate change aspects and use of community devolved funds like CDF.

3. Another recommendation is to increased support for local conservation strategies like tree planting in one of the major water catchment areas like Mau Forest, public places and spaces like schools will go to a greater extend in increasing forest cover and in the long run reduce the effect of climate change and improving livelihoods.

4. Finally, institutions and policies that exist to mitigate the effect of climate changes need to be legitimate and effective to be able to counter problems of climate change. There is need for increased community level participation in formulation and implementation of Climate change response policies. This will enhance grass root ownership of those Laws as well as collective implementation and monitoring of them towards addressing the challenges of Climate Change.

5.6 Areas for further studies

The Study only focused on Kuresoi District Community to investigate the influence of Climate Change Mitigation Strategies on their rural livelihoods. A further research can be carried out in the same community to find out on how traditional climate change mitigation strategies like change of crop patterns are effective in promoting farming as a rural livelihood. Secondly, another study can be conducted in other areas for comparison purposes.

Finally, a Comparative research can be carried to assess how Government policies and institutions on environmental conservation mitigate effects of climate change towards rural livelihoods in Kenya.

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APPENDICES

APPENDIX 1: LETTER OF TRANSMITTAL

Sylvester Oduor Abara
P.O. Box 18261 – 20100
Nakuru.
Email: sylvester.abara@gmail.com
Cell: (+254)720 930 926
5th May, 2012

Dear Respondent

RE: LETTER OF TRASMITTAL

I am M.A degree student at the University of Nairobi, Nakuru Extra-mural Centre. I am required to submit as part of my assessment a research project. Consequently I have written a proposal entitled "Influence of climate change mitigation strategies on rural livelihoods of Kuresoi district community, Nakuru county in Kenya''

To achieve this, I am interviewing selected group of respondent from the community, the CBO implementing climate change response activities, Representatives from Kenya forestry service, NGOs and GOK representative. This information will be treated with confidentiality and your name will not be mentioned in the report. Findings of the study shall help the users of the information to understand the effect of climate change on rural livelihoods in Kuresoi district and eventually provide a solution to some of the factors mentioned.

Your assistance and cooperation will be highly appreciated.

Thank you in advance

Yours faithfully,

Sylvester Oduor Abara
L50/65996/2010.

APPENDIX 2: QUESTIONNAIRE FOR COMMUNITY BASED ORGANISATIONS AND KENYA FOREST SERVICE STAFF

Instructions

This questionnaire is to be completed by:

1. *At least two (2) of the CBO Executives (Chairman, Secretary, Treasurer in each location).*
2. *At least one (1) Kenya forest service*

Please tick in the relevant boxes or fill in fill in the blank spaces

Location: _____ Date: _____

Name of your organization: _____

Respondent Profile

1. Position held by of respondents:_____
2. Age bracket
    1. Below 20 years [ ]
    2. 21-30 years [ ]
    3. 31-40 years [ ]
    4. 41- 50 years [ ]
    5. Above 50 years [ ]
3. Gender **(Tick)**: 1. Male [ ]
   2. Female [ ]
4. Highest education level attained

    1. Primary level incomplete [ ]
    2. Primary level completed [ ]
    3. Secondary level incomplete [ ]
    4. Secondary level completed [ ]
    5. University completed [ ]

Section A: Adaptation Strategies

5. Are there ways in which your organization is involved in identifying adaptation strategies in this to address the effect of climate change?

Yes 1	
No 2	

6. What are the adaptation strategies are you encouraging in this area? (Tick all that apply)

1	Change of crops patterns	
2	Cross breeding of livestock to make them hardy to climatic changes	
3	Adoption of renewable sources of energy	
4	Change of eating habit/ food preference	
5	Don't Know	
6	Others specify_____	

7. Did you involve community in identifying adaptation strategies in this location?

Yes 1	
No 2	

8. Do you know of anyone in this location who is currently applying any of the adaptation Strategies?

Yes 1	
No 2	

9. Is it the priority the community to adapt to these strategies in order to address the effect of climate change in your Location?

Yes 1	
No 2	

10. Do you know of any funding allocation by the government or NGO for responding to climate in your location?

Yes 1	
No 2	

11. How is money provided to the community?

1	Through community based organizations(e. g youth groups self-help groups and women groups)	
2	Government key departments	
3	Location committee	
4	Individuals Households	
5	Don't Know	
6	Others specify_____	

Section B: Training and awareness

12. Are community members aware of the climatic changes taking place in this area?

Yes 1	
No 2	

13. If yes, how does the community monitor or keep track of understand of climate change communication in the area? **Tick those that applies**

1	Neighbors discuss climate change issues	
2	CBO reports	
3	NGO meetings	
4	Kenya Forestry service Report	
5	Feed back during meetings	
6	Government administrators(Chief and Sub-chief) barazas	
6	Others specify_____	

14. Are you aware that livelihood problems are as a result of climate change?

Yes 1	
No	

15. Have you attended any training or forum on climate change issues? **Tick**

Yes 1	
No 2	

16. What is your level of satisfaction with the trainings or forums?

Use the following sentence to indicate 1. Satisfied 2. Fairly satisfied 3. Dissatisfied

	Indicators or (Performance Criteria)	**Level of satisfaction**
1	Location of the trainings or forums	
2	Community participation identifying the training areas	
3	Relevance of the trainings or topics discussed during these trainings or fora	
4	Quality of trainings or fora	
5	Number of the trainings that have been conducted	
6	The training or for a building the capacity of community to cope with and mitigate effects of climate change	
7	Accountability of CDF duty bearers to the community	
	Overall impact of awareness creation meetings in addressing the effect climate change on livelihoods.	

Section C: Conservation Strategies

17. What is your level of satisfaction conservation activities taking place in your location?

Use the following sentence to indicate: 1. Satisfied 2. Fairly Satisfied 3. Dissatisfied

	Indicators or (Performance Criteria)	**Level of satisfaction**
1	Tree planting in the Mau forest	
2	Establishment of protected areas	
3	Planting of trees in schools among other public venues/grounds	
4	Agro forestry	

18. In your own views, does conservation strategies have any impact in mitigating the effect of climate change on rural livelihoods?

Yes 1	
No 2	

19. Give explanation to your answer

_____

_____

_____

_____

Section D: Structural arrangement

20. Indicate your level of satisfaction with availability of institutions and policies on mitigating the effect of climate change on rural livelihoods.

Use the following sentence to indicate 1. Satisfied 2. Fairly satisfied 3. Dissatisfied

	Indicators or (Performance Criteria)	**Level of satisfaction**
1	Understanding of the availability of policies or institutions	
2	Legitimacy in application of policies or by the institutions	
3	Community involvement in policy formulation and implementation	
4	Mitigation activities carried out by the government, NGOs, KFS or community CBOs.	
5	Use of a budget drawn as a tool for fund allocation	

21. Give a comment on availability of the policies, climate change response activities carried out by the government, CBOs, KFS and community in general

_____

_____

_____

Section E: Other factors

22. Are there any challenges faced in responding to the effect of climate change on rural livelihoods? TICK

Yes 1	
No 2	

23. If yes, what challenges have you faced in your location? **Tick all that applies.**

1	Political interests	
2	Increased conflict	
3	Lack of support from the local leaders	
4	Lack of commitment by the community	
5	Inadequate resources	
6	Others specify_____	

24. From your own observation and experience, is there any challenges arising from *government policies* or *socio-economic activities* that interfere with responding to the effect of climate change on rural Livelihoods? Briefly Explain_____

_____

_____25. Suggest up to three best ways for responding to the effect of climate change on rural livelihoods within Kuresoi district especially your location?

_____

_____

_____

_____

APPENDIX 3: QUESTIONNAIRE FOR COMMUNITY REPRESENTATIVE AND THE AREA CHIEF

Instructions

This questionnaire is to be completed by:

1. *Community members representatives from all the locations*
2. *Area chiefs from each location.*

Please tick in the relevant boxes or fill in fill in the blank spaces

Location: _____ Date: _____

Name of community centre: _____

Respondent Profile

1. Position held by of respondents:_____
2. Age bracket
    6. Below 20 years [ ]
    7. 21-30 years [ ]
    8. 31-40 years [ ]
    9. 41- 50 years [ ]
    10. Above 50 years [ ]
3. Gender **(Tick)**: 1. Male [ ]
    2. Female [ ]
4. Highest education level attained

    1. Primary level incomplete [ ]
    2. Primary level completed [ ]
    3. Secondary level incomplete [ ]
    4. Secondary level completed [ ]
    5. University completed [ ]

Section A: Adaptation Strategies

5. Are there ways in which the community is involved in identifying adaptation strategies in your location to address the effect of climate change?

Yes 1	
No 2	

6. What are the adaptation strategies in your areas? (Tick all that apply)

1	Change of crops patterns	
2	Cross breeding of livestock to make them hardy to climatic changes	
3	Adoption of renewable sources of energy	
4	Change of eating habit/ food preference	
5	Don't Know	
6	Others specify_____	

7. Did you take part in identifying community adaptation strategies in your location?

Yes 1	
No 2	

8. Do you know of anyone in your location who is currently applying any of the adaptation Strategies?

Yes 1	
No 2	

9. Is it the priority the community to adapt to these strategies in order to address the effect of climate change in your Location?

Yes 1	
No 2	

10. Do you know of any funding allocation by the government or NGO for responding to climate in your location?

Yes 1	
No 2	

11. How is money provided to the community?

1	Through community based organizations(e. g youth groups self-help groups and women groups)	
2	Government key departments	
3	Location committee	
4	Individuals Households	
5	Don't Know	
6	Others specify_____	

Section B: Training and awareness

12. Are community members aware of the climatic changes taking place in the area?

Yes 1	
No 2	

13. If yes, how does the community monitor or keep track of understand of climate change communication in the area? **Tick those that applies**

1	Neighbors discuss climate change issues	
2	CBO reports	
3	NGO meetings	
4	Kenya Forestry service Report	
5	Feed back during meetings	
6	Government administrators(Chief and Sub-chief) barazas	
6	Others specify_____	

14. Are you aware that livelihood problems are as a result of climate change?

Yes 1	
No	

15. Have you attended any training or forum on climate change issues? **Tick**

Yes 1	
No 2	

16. What is your level of satisfaction with the trainings or forums?

Use the following sentence to indicate 1. Satisfied 2. Fairly satisfied 3. Dissatisfied

	Indicators or (Performance Criteria)	**Level of satisfaction**
1	Location of the trainings or forums	
2	Community participation identifying the training areas	
3	Relevance of the trainings or topics discussed during these trainings or fora	
4	Quality of trainings or fora	
5	Number of the trainings that have been conducted	
6	The training or for a building the capacity of community to cope with and mitigate effects of climate change	
7	Accountability of CDF duty bearers to the community	
	Overall impact of awareness creation meetings in addressing the effect climate change on livelihoods.	

Section C: Conservation Strategies

17. What is your level of satisfaction conservation activities taking place in your location?

Use the following sentence to indicate: 1. Satisfied 2. Fairly Satisfied 3. Dissatisfied

	Indicators or (Performance Criteria)	**Level of satisfaction**
1	Tree planting in the Mau forest	
2	Establishment of protected areas	
3	Planting of trees in schools among other public venues/grounds	
4	Agro forestry	

18. In your own views, does conservation strategies have any impact in mitigating the effect of climate change on rural livelihoods?

Yes 1	
No 2	

19. Give explanation to your answer

_____

_____

_____

Section D: Structural arrangement

20. Indicate your level of satisfaction with availability of institutions and policies on mitigating the effect of climate change on rural livelihoods.

Use the following sentence to indicate 1. Satisfied 2. Fairly satisfied 3. Dissatisfied

	Indicators or (Performance Criteria)	**Level of satisfaction**
1	Understanding of the availability of policies or institutions	
2	Legitimacy in application of policies or by the institutions	
3	Community involvement in policy formulation and implementation	
4	Mitigation activities carried out by the government, NGOs, KFS or community CBOs.	
5	Use of a budget drawn as a tool for fund allocation	

21. Give a comment on availability of the policies, climate change response activities carried out by the government, CBOs, KFS and community in general

_____

_____

Section E: Other factors

22. Are there any challenges faced in responding to the effect of climate change on rural livelihoods? TICK

Yes 1	
No 2	

23. If yes, what challenges have you faced in your location? **Tick all that applies.**

1	Political interests	
2	Increased conflict	
3	Lack of support from the local leaders	
4	Lack of commitment by the community	
5	Inadequate resources	
6	Others specify_____	

24. From your own observation and experience, is there any challenges arising from *government policies* or *socio-economic activities* that interfere with responding to the effect of climate change on rural Livelihoods? Briefly Explain_____

    _____

    _____

25. Suggest up to three best ways for responding to the effect of climate change on rural livelihoods within Kuresoi district especially your location?

    _____

    _____

    _____

APPENDIX 4: INTRODUCTION LETTER

UNIVERSITY OF NAIROBI
COLLEGE OF EDUCATION AND EXTERNAL STUDIES
SCHOOL OF CONTINUING AND DISTANCE EDUCATION
DEPARTMENT OF EXTRA - MURAL STUDIES

Tel 051 - 2210863

P. O Box 1120, Nakuru
6th July 2012

Our Ref: *UoN/CEES/NKUEMC/1/12*

To whom it may concern:

RE: SYLVESTER ODUOR ABARA – L50/65996/2010

The above named is a student of the University of Nairobi at Nakuru Extra-Mural Centre Pursuing a Masters degree in Project Planning and Management.

Part of the course requirement is that students must undertake a research project during their course of study. He has now been released to undertake the same and has identified your institution for the purpose of data collection on "Influence of Climate Change Mitigation Strategies on Rural Livelihoods of Kerosoi District Community, Nakuru County, Kenya".

The information obtained will strictly be used for the purpose of the study.

I am for that reason writing to request that you please assist him.

Yours Faithfully,

NAKURU EXTRA-MURAL CENTRE
RESIDENT LECTURER
P.O. Box 1120
NAKURU

Joseph C. Mungai
Resident Lecturer, University of Nairobi
Nakuru Extra-Mural Centre

APPENDIX 5: RESEARCH PERMIT

OFFICE OF THE PRESIDENT
PROVINCIAL ADMINISTRATION AND INTERNAL SECURITY

Telegrams: Districter" Kuresoi"
Telephone: Kuresoi
Fax: 0202026644448
Email: dckuresoi@yahoo.com
When replying pleases quote
REF: ED 12/10 VOL I/23

THE DISTRICT COMMISSIONER
KURESOI DISTRICT
P.O.BOX 2,
KERINGET

10TH JULY 2012

MR. SYVESTER ODUOR ABARA

RE: ACADEMIC RESEARCH -KURESOI

Your request to carry out research in this district has been granted.

Please carry with you a copy of university letter giving you authority for the research wherever you are within the district.

DISTRICT COMMISSIONER
DATE.....
P.O.BOX 2 KERINGET
KURESOI DISTRICT

RASHID KWANYA
FOR: DISTRICT COMMISSIONNER
KURESOI DISTRICT