COMMUNITIES' AWARENESS ON CLIMATE CHANGE AND ITS EFFECTS: A CASE STUDY OF TRANS NZOIA DISTRICT, KENYA.

BY

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DECLARATION

I hereby declare that the following research report is my original work and where others' literature are cited or quoted, relevant sources have been duly acknowledged and that it has never been presented or forwarded to any University or any other Institution of Higher Learning for the purpose of obtaining any Academic Credit or Award.

Signature .....

Victor Otieno Mgelle

Date .....11.06.10.....

APPROVAL

I certify that this research report submitted by the candidate was done under my supervision and that the work is ready for submission for award of the degree of Bachelor of Science in Environmental Management of Kampala International University.

.....

Ms. Anne Tumushabe

(Supervisor)

Date ...10/06/10.....

DEDICATION

This research report is written in honor of my beloved parents, James .A. Mgelle and Rosemary .A. Mgelle and all my siblings including my sister Florence Johnson and brother in law George .H. Johnson II. May the almighty God grant you the gift of long life and happiness together.

I would also like to dedicate this work to the people of Trans Nzoia District and the entire Republic of Kenya who are currently faced with the climate change dilemma but are nevertheless taking the challenge in stride to better their opportunities. May we all triumph in this enormous undertaking of combating global climate change and its effects.

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TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS AND ACRONYMS

AGW	Anthropogenic Global Warming
CO_2	Carbon dioxide
Gt	Gigatonnes
IPCC	Intergovernmental Panel on Climate Change
WMO	World Meteorological Organization
UNEP	United Nations Environment Program
UNFCCC	United Nations Framework Convention on Climate Change
NCCACC	National Climate Change Activities Coordinating Committee
NRC	National Research Council
GEF	Global Environment Facility
GHG	Greenhouse Gases
NGO	Non Governmental Organization
CBO	Community Based Organization
SCC-Vi	Swedish Cooperative Centre
NEMA	National Environment Management Authority
ACTS	African Centre for Technology Studies
SEI	Swedish Environmental Institute
CNA	Climate Network Africa

DEFINITON OF TERMS

Climate Change: is a change in the statistical distribution of weather over periods of time that range from decades to millions of years. It can be a change in the average weather or a change in the distribution of weather events around an average (for example, greater or fewer extreme weather events). Climate change may be limited to a specific region, or may occur across the whole Earth. It can be caused by recurring, often cyclical climate patterns such as El Niño-Southern Oscillation, or come in the form of more singular events such as the Dust Bowl.

Anthropogenic Global Warming: is a term used to describe a potentially dramatic rise in the annual average global surface temperature of the earth usually occasioned by a sharp increase in the amount of greenhouse gases in the earth's atmosphere

Climate Forcings: These include such processes as variations in solar radiation, deviations in the Earth's orbit, mountain-building and continental drift, and changes in greenhouse gas concentrations.

Orbital Variations: Slight variations in Earth's orbit lead to changes in the seasonal distribution of sunlight reaching the Earth's surface and how it is distributed across the globe.

Volcanism: Volcanism is a process of conveying material from the crust and mantle of the Earth to its surface. Volcanic eruptions, geysers, and hot springs, are examples of volcanic processes which release gases and/or particulates into the atmosphere.

ABSTRACT

Global climate change is caused by the accumulation of greenhouse gases in the lower atmosphere that trap radiant heat thereby leading to an accelerated anthropogenic greenhouse effect that has huge negative global ramifications. Awareness levels on the very existence of the climate change issue is currently very low especially in areas considered to be most vulnerable to the anticipated changes thereby informing the research undertaken titled *"Communities' Awareness on Climate Change: A Case Study of Trans Nzoia District, Kenya"* The scope of the study was defined and objectives set in line with the purpose of the study. Variables investigated and assessed in the field were the level of awareness of communities to climate change, its causes and observable evidences in the study area, the effects of climate change on the livelihoods and socio-economic activities of the communities under study and finally the government and international organization programmes put in place to help the communities with mitigation and adaptation of the climate change effects. A total sample size of 100 respondents (N=100) was chosen through systematic random sampling for community members such as farmers, pastoralists and community leaders at household levels which was the basic sampling unit and purposive sampling was used to select respondents from government departments such as extension officers and technical staff respondents from non-governmental and international organizations in the study area. Primary data was obtained through use of questionnaires, interviews, focus group discussions and literature reviews. The results of the study established that general awareness on the climate change issue was very low especially among adults with low levels of formal education thereby corresponding to similar research done by Gallup that ascertained that education levels serve as the best correlate of climate change awareness all over the world. The study also established the effects of climate change on the livelihoods and socio-economic welfare of communities in Trans Nzoia as having been negative with regard to the declining agricultural productivity especially in farming and Pastoralist activities which have been affected most in terms of failed harvests and death of livestock due to extended dry conditions, reduction in water quality and quantity, social dislocation in form of mass migrations due to search for arable land and pastures and finally increase in tropical infectious diseases such as malaria. The study also acknowledged that despite the presence of numerous governmental and international organization programmes in the study area aimed at promoting climate change mitigation and adaptation measures, the awareness apathy as to the dynamic nature of the climate phenomenon has not enabled the programmes to provide sufficient prevention and compensation of the adverse effects suffered by these vulnerable communities. The study concluded that lack of awareness of climate change issues compounded the severity of negative consequences experienced by the most vulnerable communities. Recommendations for reversing the negative conclusions such as raising awareness levels through introducing environmental education in school curricula, raising public awareness on climate change effects, establishing indigenous knowledge reservoir centre's and finally adopting a needs based, locally oriented climate change mitigation and adaptation measures were made in accordance with the significance of the research study.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Climate change is a change in the statistical distribution of weather over periods of time that range from decades to millions of years. It can be a change in the average weather or a change in the distribution of weather events around an average (for example, greater or fewer extreme weather events). Climate change may be limited to a specific region, or may occur across the whole Earth. It can be caused by recurring, often cyclical climate patterns such as El Niño-Southern Oscillation, or come in the form of more singular events such as the Dust Bowl.

In recent usage, especially in the context of environmental policy, climate change usually refers to changes in modern climate. It may be qualified as anthropogenic climate change, more generally known as "global warming" or "anthropogenic global warming" (AGW). *Gl obal warming* is a term used to describe a potentially dramatic rise in the annual average global surface temperature of the earth usually occasioned by a sharp increase in the amount of greenhouse gases in the earth's atmosphere (Houghton *et al.*, 1996).

The above is informed by the fact that the earth is warming up by an estimated range of 4° C from the natural geosystemic range of 1.5° C required to keep the earth's energy balance at equilibrium. In addition, there is now overwhelming scientific consensus that the above is not only happening, but is infact largely human-induced. Many scientists agree that climate change may be one of the greatest threats facing the planet. Recent years show increasing temperatures in various regions, and/or increasing extremities in weather patterns.

The above temperature changes have had a myriad of profound effects that have resulted to the significant alteration of the once relatively reliable weather patterns experienced in most regions around the globe and instead replaced them with unpredictable severe weather events such as hurricanes and typhoons which usually leave a trail of devastating effects once they occur. With climate change leading to global warming on the increase and species and their habitats on the decrease, chances for ecosystems to adapt naturally are diminishing.

The rainfall distribution in areas most devastated by the effects of climate change has undergone profound negative alteration and so has all the variables that we use as indicators to describe the weather and climate. There exists good evidence that this change is due to mainly, increasing amounts of carbon dioxide (CO_2) in the earth's atmosphere. The above together with other greenhouse gases act to trap outgoing thermal radiation which then warms up the surface of the earth.

With the onset of the industrial revolution in the 1700's, increasing use has been made of fossil fuels which release large amounts of carbon dioxide into the atmosphere when burnt (Weyant and Yanigisawa, 1998). The industrial and domestic energy demands of our modern society mean that approximately 7 gigatonnes (Gt) of carbon from hydrocarbon compounds is released into the atmosphere every year (Houghton *et al.*, 1996). Consequently, as our technical ability has increased, so has our potential for altering the environment in which we live.

Further complicating this situation is the over-reliance on ecosystem goods and services that has lead to massive over-exploitation of natural resources such as timber harvesting and charcoal burning by poor countries hence resulting into deforestation on a global scale. Since forests are the second largest carbon sinks after the world's oceans, their destruction has magnified and accelerated the rate at which climate change and hence global warming has occurred, especially in the last quarter of the past century.

Recently issues of health and spread of tropical diseases, rising sea levels and the threat of lowland islands being submerged, food security and crop resilience to changing climatic patterns, migrations and conflicts due to droughts, unpredictable catastrophes such as typhoons and hurricanes have all been attributed to the phenomenon of climate change and scientists have predicted that the situation is bad but will even get worse unless global ramifications are put into play immediately.

With such profound consequences, and the culprit for the changes known, it might be thought negligent of the global community if no attempt was made to address the situation. Consequently, there have been world-wide efforts to tackle climate change and global warming. By 1988, the global scientific community had been canvassed and the consensus opinion was that the predicted changes in climate were significant enough to warrant action to curb greenhouse gases. The Toronto Conference in Canada that year led to the setting up of the

Intergovernmental Panel on Climate Change (IPCC) by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP).

The role of IPCC was to examine the scientific evidence and report back to the world leaders. There followed a series of high profile meetings aimed at addressing this problem which led to the Rio Earth Summit in 1992. At this meeting, the United Nations Framework Convention on Climate Change (UNFCCC) was adopted by the signatories. This was essentially a commitment to stabilize greenhouse gases in the atmosphere at a level that would not endanger the *climate system* and was interpreted by most signatories as meaning a return to 1990 emission levels of greenhouse gases by the year 2000 (Howes *et al.*, 1997).

The reason why so little has been achieved despite dire warnings, has been attributed to lack of awareness and consequently, this has resulted in increased public environmental commitment and exhortations for businesses to 'go green' (Wheatley, 1993). The answer most likely lies in the fact that there is no *quick fix* as every facet of life in the modern developed world seems to require the consumption of fossil fuels coupled with the perception that for increased economic growth, there must be increased energy consumption hence greenhouse gas emissions.

The argument is that to put the brake on carbon dioxide emissions will seriously impede our economic welfare (Nordhaus and Yang, 1996). Some of the most powerful lobbying groups in the world have been highly successful at getting this message across, not only to politicians and policy-makers, but also to the public. The result has been to inculcate in people a fear of economic recession and to create a scientific uncertainty surrounding the problem.

The science has been interpreted to serve a range of vested interests and resulted in disparities between scientific messages that presents a confused picture of climate change and global warming to the public. Therefore, it is important to understand the science of global warming and climate change so that we can appreciate the nature of the problem and the difficulties of providing scientific certainty. This then allows us to assess the claims and counter-claims of scientists and appreciate much wider arguments of economists, social scientists and politicians.

1.2 Statement of the Problem

That climate change affects almost all spheres of life, and results in negative effects being experienced by communities in Kenya is a fact that eludes many. Majority of the people in Kenya are averse to the fact that the changing fortunes being felt as a result of environmental stressors becoming seemingly incremental in nature, is by and large mainly the result of climate change and global warming to which Kenya as a country is a negligible contributor of GHG emissions that directly fuel the phenomenon.

Comprising some of the most fertile Highlands in Kenya, Trans Nzoia District has practiced agriculture as the mainstay of its economy. The contribution of this District to the Kenyan GDP declined from 24.5 % in 1964 to 12.2 % in 1999. Being the basis for food security, economic growth, employment creation and foreign exchange generation, the effect of climate change on agricultural productivity in the district is of grave concern since even most of the industrial and manufacturing firms are agro-based.

Climate change projections to the year 2030 indicate increasing temperature changes with doubling of CO_2 levels from baseline scenarios resulting into a decline in precipitation in the highland areas such as those found in Trans Nzoia District. This will lead to reduction in maize yields. The effect of climate change on livestock would be shortage of forage, increased disease incidences and breakdown of marketing infrastructure. Adaptation options in the agriculture sector would include: development of early maturing and high yielding crop varieties and adaptation of agricultural technologies from analogue environments.

The lack of awareness by communities as to the dynamic and intricate nature of the science of climate change occasioned by the very technical overlaps in the components of the environment has not further helped in the pursuit of climate change mitigation and adaptation. At the receiving end of the devastating effects of climate change are the most poor and vulnerable communities of Trans Nzoia District who are forced to rely on government support in food production despite the fact that the area is the bread basket of Kenya. This research therefore assessed the level of awareness of these local communities on this issue of climate change and its effects on their livelihoods.

1.3 Objectives of the Study

The objectives of carrying out this research was categorized into two parts in order to narrow down on the knowledge of communities to both the existence of climate change and how they have experienced its effects. This was as follows:

1.3.1 General Objective

- To ascertain the level of awareness of the communities under investigation on climate change and its effects on their livelihoods and social economy.

1.3.2 Specific Objectives

- To find out the communities' awareness level of climate change, its causes and observable evidence in the area under study.
- To examine the effects of climate change on the livelihoods and socio-economic activities practiced by the communities in Trans Nzoia District.
- To identify government and international organization programmes put in place to help communities in adaptation and mitigation of climate change effects.

1.4 Research Questions

- What is climate change according to you?
- What are the causes of climate change and which observable evidences support its occurrence?
- What are the effects of the changing climatic patterns on the socio-economic activities carried out by the communities of Trans Nzoia?
- What government and international organization programmes have been put in place to help the affected communities cope with the effects of climate change?

1.5 Purpose of the Study

The purpose of carrying out this research was primarily to focus on the level of awareness and hence vulnerability of communities to the effects of climate change in the area under study with the view of highlighting the relevant knowledge held across different social groups and academia as concerns the climate change forum. Natural resource depletion and erratic weather patterns in the form of both long drought spells and frequent flash floods coupled with the re-emergence of tropical diseases and spread of malaria is undermining the livelihoods and future opportunities of the rural poor in Trans Nzoia.

Therefore, this research was intended to expressly establish whether the communities under investigation are aware as a matter of fact that the above occurrences are as result of a wider phenomenon currently dominating the world stage. The research was also intended to establish both the adaption and mitigation measures, if any, that have been put in place to help these vulnerable communities. The intended research proposal was also meant to assist in highlighting the role of indigenous knowledge held by some communities and their relevance in the climate change debate.

1.6 Scope of the Study

The contextual and geographical scope of the research study covered an area with dualistic characteristics across the entire Administrative District of Trans Nzoia. Special emphasis was put to ensure areas studied were diverse and comprised of both high agricultural potential and also marginal potential (Arid and Semi Arid Land). Trans Nzoia District encompasses three Constituencies namely; Cherangany, Kwanza and Saboti, all of which experience varied conditions of climate due to their location.

The research therefore, also highly endeavored to ascertain the communities' point of view on the experienced effects that climate change has had on the different agro-ecological zones. Cherangany constituency occupies a forested zone and is one of Kenya's five main water towers while Saboti constituency comprises the most agriculturally fertile highlands in the region and

also has Mount Elgon while Kwanza extends northwards towards the Frontier borderline and therefore experiences harsh arid conditions.

The Socio-economic activities and livelihoods of the people in these three areas therefore differ considerably and likewise was their perception to climatic changes and the extent of the effects to the disruption or improvement of their living conditions. The research was therefore conducted on the basis of ascertaining the community's awareness to climatic effects on rainfall variation, water availability, agricultural productivity and tropical disease spread.

1.7 Significance of the Study

This research project was seeking to create an awareness of climate change vulnerabilities and adaptation strategies among the Trans Nzoia communities. It was also meant to work in strengthening the capacity of the Local Community Knowledge Centre as a reservoir for climate change adaptation information by focusing on indigenous knowledge systems.

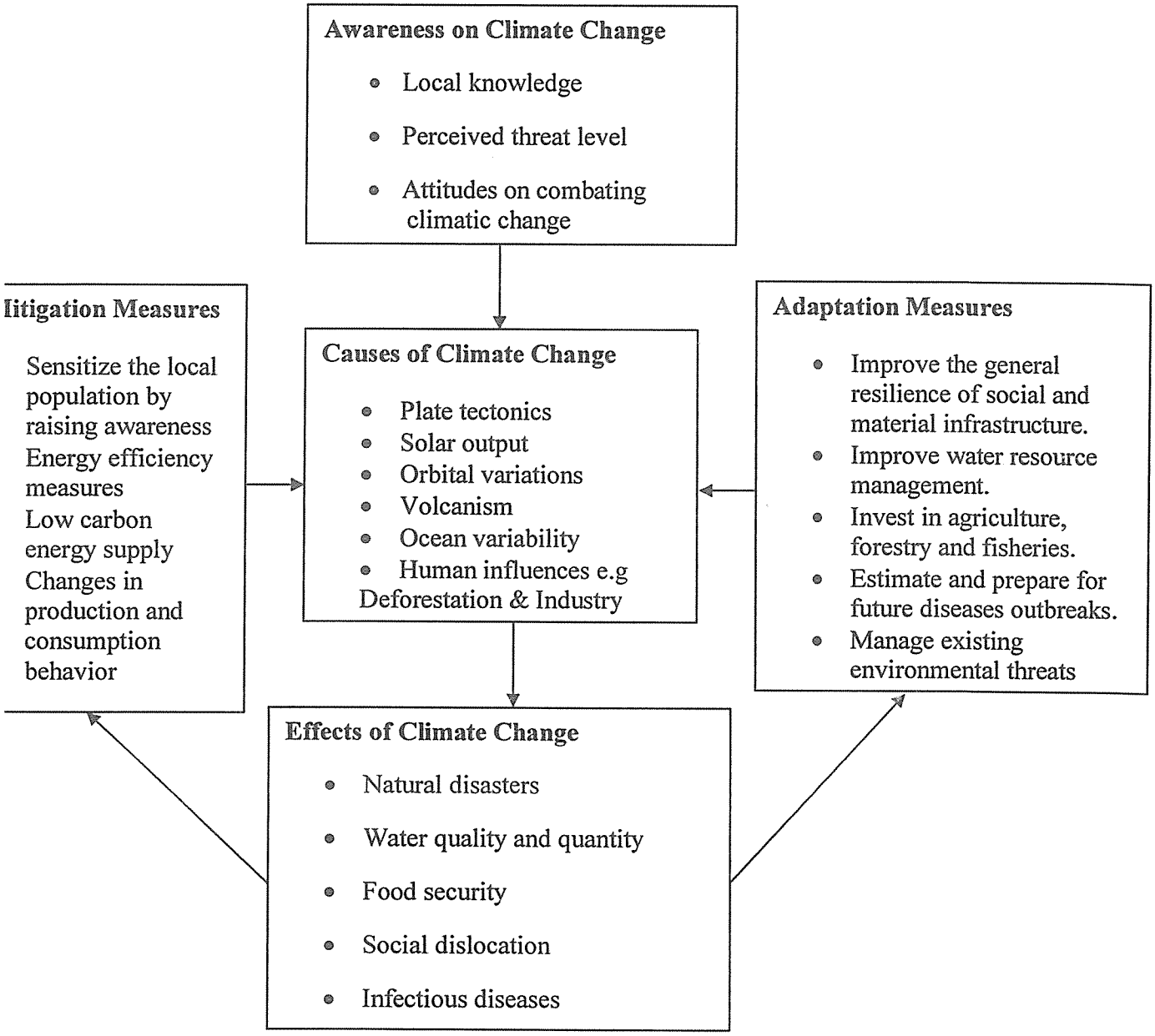
Food insecurity, prolonged droughts, diminishing water supplies, erratic rainfall patterns and hailstorms are the most obvious effects of climatic change on rural communities in Trans Nzoia District. However, at present there is very limited understanding on the causes of these changes or of the best practices required to achieve climate adaptation strategies within these communities. In part due to this lack of understanding and in part due to high levels of poverty, communities engage in economic activities that degrade the environment, such as deforestation, with consequences for the regulation of local climate. The resulting climatic changes aggravate the multiple vulnerabilities experienced by men and women in these communities and push them further into a situation of chronic poverty.

Therefore the research was meant to be of great value to Government, Academicians and Environmentalists as well as the Communities themselves by highlighting the following:

- It revealed the level of awareness of the local communities on what climate change is
- It addressed the knowledge gap on the causes and effects of climate change on communities.

- It provided insights into the perception and role of indigenous knowledge towards helping communities understand relevant climate change data.
- It provided government and other international agencies with baseline information from which individual communities' needs for adaptation can be assessed.
- Finally, the study enabled the researcher attain the requirements leading to the award of a Bachelor of Science Degree in Environment Management.

1.8 Conceptual Framework



iption of Relationships

of awareness by communities on climate change, coupled with limited understanding of the threat it poses to ivelihoods through its causes and effects, both natural and anthropogenic as described above has resulted into conditions being experienced by local populations. These in turn result into modification of the human nment in negative ways leading to socio-economic problems such as food shortages and spread of pests and es. Adaptation and mitigation measures are then the only available avenues for addressing climate change gh alleviating the negative effects and providing alternatives for resource exploitation that are sustainable and the long run increase or sensitize the local population by raising their awareness on the phenomenon.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter provides the background and context for the research problem. With such background, the researcher was able to justify the need for further research into the subject in question. The researcher was also able to relate the study to the larger ongoing dialogues and debates on the literature about the topic and in filling the gaps and finally extending prior studies.

2.2 Local Knowledge and Awareness on Climate Change in East Africa

There is a huge gap in the knowledge on the effects of climate change in East Africa. At the moment, very little research is being done that gives a clear picture on the modeling of effects in this sub-region on climate change. The local communities in the region are generally aware of the issue of climate change though they do not necessarily understand or perceive it from the scientific point of view especially the rural population with fairly low levels of formal education and limited access to materials relating to the ongoing global climate debate issues. (ACTS/SEI)

Climate change has been interpreted to simply refer to the drastically changing weather patterns and seasons with very little inference being made to its relationship with the common global trend phenomenon. Only among the educated and exposed population is one likely to find awareness levels to the effects of climate change well known and perceived to the extent of correlation between the variability in conditions being attributed to the more scientifically established causes of climate change. (CNA)

Definitions such as climate change referring to periodic modification of the Earth's climate brought about as a result of changes in the atmosphere as well as interactions between the atmosphere and various other geologic, chemical, biological, and geographic factors within the Earth's system can rarely be gotten even from those educated until undergraduate level with most of them understanding climate change to be the change in average weather over time and over a region. Climate change to them includes changes in temperature, wind patterns and precipitation. (CNA)

By contrast, Kenya is way ahead of its regional neighbors as far as raising awareness levels on climate change is concerned. With adequate International Organizations concerned with climate change issues having regional secretariats based in Kenya, it has managed fairly well to come up with climate change response programs that ensure community level participation hence raising awareness levels as compared to Tanzania and Uganda who are making slow but sure progress on becoming more vocal on the global climate change forum. (UNFCCC)

2.3 Global Attitudes towards Climate Change: (Case Study)

Within the context of the dialogue currently taking place about climate change, it is instructive to understand worldwide public opinion and attitudes about the issue. During 2007 and 2008, Gallup conducted the first comprehensive survey of global opinions about climate change, asking respondents specifically about their awareness of the issue and the extent to which they perceive climate change as a threat to themselves and their families.

Gallup surveyed a total of 206,193 residents in 128 countries, representing more than 90 percent of the world's population aged 15 and older. Each country's sample is representative of both urban and rural areas. Country data were weighted by population to provide global and regional estimates.

Gallup's major findings are that a majority of the world's adult population is aware of the climate change issue, but a substantial minority is not aware. Further, those who are aware are more likely to say climate change poses a serious threat to themselves and their families. Results did vary by region and among each of the top five green house gas-emitting countries, underscoring the challenges leaders face in reaching a global climate agreement.

2.3.1 Climate Change: Awareness and Knowledge

The first question--"How much do you know about global warming or climate change?"--gave respondents three choices: "I have never heard of it, I know something about it, or I know a great deal about it." Although people's awareness of climate change and perceptions about its effects vary at the region and country levels, the overall patterns illustrate how climate change is a truly global issue.

Gallup's data reveal that a majority of the world's adult population--61 percent--knows at least something about climate change or global warming. A breakdown of this 61 percent shows that half of the world (50 percent) knows "something" about the subject, while slightly more than one in ten people (11 percent) knows a "great deal." A sizable minority of (39 percent) has never heard of climate change nor has no opinion. Because a self-report measure was used in the research, rather than a test of actual knowledge, this 39 percent may represent a conservative estimate of the world's population that is unaware of the climate change issue.

Regionally, people in Europe and the Americas (which includes North, South, and Central America) are the most likely to be aware of climate change. More than eight in ten adults in Europe and the Americas say they know at least something about climate change. In addition, these two regions have the greatest percentage of adults who report knowing a great deal about the issue.

Lower awareness is evident in the Middle East/North Africa, Asia, and sub-Saharan Africa regions. Slightly more than half of adults in the Middle East/North Africa and Asia regions report basic awareness of climate change. Awareness is lowest among adults in sub-Saharan Africa, where 44 percent of adults report knowing at least something about the issue of climate change as concerns its meaning and effects on their livelihoods and future implications.

Gallup's analysis shows that educational attainment serves as the single best correlate of awareness and knowledge of climate change across regions. Adults with eight years of education or less are least likely to say they know something about climate change (42 percent). Awareness is significantly higher among those with nine to fifteen years education. Nearly all adults--91 percent--with a four-year college/university degree report awareness of climate change; however, less than a third of this highly educated segment knows a great deal about the issue.

The relationship between educational attainment and awareness of climate change is particularly evident in areas of the world where self-reported knowledge of climate change is lowest. In sub-Saharan Africa, for instance, awareness is lowest among adults with no formal education and increases dramatically with level of education.

The above responses were coded and represented quantitatively as shown below for ease of both understanding and comparison purposes.

2.3.2 Gauging Global Awareness of Climate Change

	How much do you know about global warming or climate change?				
	Have not heard of it	Know something about it	Know a great deal about it	Don't know/ Refused	Aware
World	24%	50%	11%	15%	61%
Europe	8%	70%	18%	4%	88%
Americas	14%	64%	17%	4%	82%
Asia	24%	45%	8%	23%	53%
Middle East/North Africa	41%	42%	10%	7%	52%
Sub-Saharan Africa	48%	37%	7%	9%	44%

Based on surveys in 128 countries. Data weighted to 2008 World Bank adult population estimates: Gallup; 2007-2008

Education and the Climate

How much do you know about global warming or climate change? (Global Figures)

	Know something about it	Know a great deal about it	Never heard of it/Don't know/Refused
Up to 8 years of education	37%	5%	58%
9 to 15 years of education	63%	14%	23%
4 years or more of university	61%	30%	9%

Note: Table made from bar graph.

Source: Gallup Report, 2007/2008.

2.3.3 Big Emitters

Together, China, the United States, India, Russia, and Japan account for more than half of the world's greenhouse gas emissions. Separately, each has started down the path toward Copenhagen from different places and each has its own perspectives on the responsibility of

developed and developing nations. Many observers believe the top emitters--particularly China and the United States--will need to walk together to get others to follow.

Public opinion about climate change across this mix of developed and major developing economies reveals areas of common ground as well as of division. In China, which rivals the United States for the top spot on the greenhouse gas emitters list, the 62 percent who are aware of climate change falls roughly at about the world's average. However, China stands out among these five countries because its public perceives global warming as a relatively low threat.

The lower figures in China surprise William Chandler, a senior associate with the Carnegie Endowment for International Peace and an expert on climate and energy. He says climate change receives a lot of press in China, and it is clear that the Chinese government is serious about the issue. However, he notes that within the country, in terms of people's priorities and the seriousness of the threat, the risks of global warming may seem a little far off to the public. Gallup's survey, which is representative of both urban and rural areas, reveals that the general Chinese perception of climate change as a relatively low threat is pervasive across demographic and geographic groups.

Awareness is higher among urban Chinese (77 percent) than rural Chinese (52 percent). But even within urban and rural areas, education has an independent, additional effect on awareness. As education levels increase, so does basic awareness of climate change. When we separate those adults who are aware, we find that urban Chinese are only slightly more likely than rural Chinese to perceive climate change as a serious issue to them personally. Although education does have an independent effect on perceptions, all groups show a relatively low level of perceived threat of climate change.

Like China, India is one of the fastest expanding economies in the world, and as such, its energy needs will only increase over the next decade. Still largely agrarian and poor, India has opposed emissions caps that could potentially curb its growth and maintains that developed nations should shoulder most of the burden. However, India has committed to not increasing its per-capita emissions above those of developed countries and is increasingly looking into alternative fuel options and energy efficiency at home.

Of the top five greenhouse gas-emitting countries, awareness is lowest in India, where only about a third of adults say they know at least something about climate change. As in China, this awareness correlates with urbanicity and educational attainment. In urban India, 49 percent of adults know at least something about climate change, whereas in rural India--where more than two-thirds of the population lives--29 percent does.

Within urban and rural India, awareness increases significantly with educational attainment. While Indians are the least likely of the top five GHG-emitting countries to report awareness of climate change, they are more likely than the Chinese to say the issue is serious to them. Indians who are aware of the issue are likely to perceive it as a serious personal threat (29 percent of the total adult population in India).

As India's energy needs increase over the next decade, the country will likely face a challenge as it communicates climate and environmental measures to a public that is highly unaware of the climate change issue. In Japan, Russia, and the United States, interestingly, where awareness is substantially higher than in China or India, perceptions vary about the seriousness of the threat that climate change poses.

2.3.4 Climate Consciousness in the Industrializing Nations

Awareness of Climate Change in China and India by Educational Attainment

	Percent of respondents aware			
	China		India	
	Urban areas	Rural areas	Urban areas	Rural areas
Up to 8 years of education	63%	47%	42%	25%
9 to 15 years of education	86%	78%	53%	47%
4 years or more of university *	98%		72%	

* Sample size of rural Chinese and Indians with 4 years or more of university education too small to report results.

Note: Table made from bar graph.

Source: Gallup Report, 2007/2008.

2.3.5 Perceived Global Threat Level of Climate Change

The second question, how serious of a threat does climate change and global warming pose to you and your family? Gave respondents a choice of four answers; very serious, somewhat serious, not very serious or not serious at all. Once again the responses clearly show how global the nature of climate change is and how diverse the personal opinions of respondents differ across the global spectrum.

Of the citizens from the top five greenhouse gas-emitting countries, the Japanese are the most likely to say global warming represents a serious threat to themselves and their families, with 80 percent rating the phenomenon at this threat level. It is too early to tell what impact the recent government change will have on climate change policy in the world's second-largest economy. Japan's Democratic Party, which swept to power in late August, had pledged to cut emissions even deeper than the outgoing government. Such efforts may be a tough sell, however, as Japan emerges from deep economic recession.

Historically, the United States is the only country among the top five emitters not to ratify the Kyoto protocol. However, since the Obama administration took office, climate change policies have started to shift. Results from Gallup's surveys in 2007 and 2008 show that almost all US citizens aged fifteen and older are aware of climate change, but a sizable 35 percent do not believe climate change is a serious threat. In this way, the United States is similar to Russia and China, where more than one-third of the population is aware of climate change but does not see it as posing a threat.

Additional Gallup polling in the United States on the environment has examined attitudes about global warming for more than two decades. These surveys reveal that the percentage of US citizens who are worried about global warming has varied historically, but in 2009, concern is at the same level it was 20 years ago. In a March 2009 survey, Gallup noted a lower level of concern among US citizens about climate change on several measures compared with 2008. The lower level of concern may stem from the current focus on the country's economic troubles or be associated with the increased public perception that the media's presentation of climate change is exaggerated.

In Russia, one of the world's most energy-intensive economies, there are signals this year that climate policy is starting to undergo a shift. For the first time, Russia recently announced long-term plans for reducing emissions. At the same time, there may be reluctance to do so at a cost to economic growth as Russia experiences a deep slowdown. Despite high awareness among the Russian public, a minority of 39 percent is aware of global warming and says it presents a serious threat. In this regard, Russians' attitudes more closely align with attitudes in India and China than with those in Japan or the United States.

In sub-Saharan Africa, Asia, and the Middle East/North Africa regions, where populations are more likely to be vulnerable to the effects of climate change, the perceived threat is nonetheless relatively low and far more subdued than in the Americas or Europe. This can be attributed to lower awareness and lower likelihood of concluding that global warming will have serious consequences.

According to the polls, 36% of adults in sub-Saharan Africa are aware of climate change and perceive it as a serious threat to themselves and their families. As a whole, the region has the lowest carbon emissions in the world, yet some experts believe its people will likely suffer most from climate change.

How serious of a threat is global warming to you and your family -- very serious, somewhat serious, not very serious, or not at all serious?

	Very/Somewhat serious	Not very/Not at all serious	Don't know/ Refused	Not aware
World	41%	18%	2%	39%
Americas	67%	15%	1%	17%
Europe	59%	25%	4%	12%
Middle East/ North Africa	42%	9%	1%	48%
Sub-Saharan Africa	36%	7%	1%	56%
Asia	32%	20%	2%	46%

Based on Gallup's surveys in 128 countries between 2007 and 2008. Data weighted to 2008 World Bank adult population estimates.

GALLUP POLL

2.3.6 Conclusions and Implications

Gallup's findings illustrate some of the challenges that leaders face as they try to forge domestic and international climate change policy that is perceived as fair and acceptable to everyone. "You can tell a story from each of the regions that is consistent with what we would assume, but also with some of the underlying economic and cultural differences," Chandler says. "It reflects the problem of getting to a global deal." Our findings suggest public opinion can play an important role in the dialogue about international and domestic climate change efforts. A majority of adults around the world report knowing at least something about climate change. However, a substantial minority is not aware, and awareness which is the foundation for understanding climate change also tends to be lowest where populations are more vulnerable to climate change.

Leadership and communication can make a difference in the public's awareness and reaction to environmental measures. Chandler cited a recent case in which the Indian government imposed a ban on gasoline-fired three-wheelers and trucks in New Delhi. The government instituted a "very draconian set of measures," he says, but fortunately there was good leadership from the scientific community to explain why they were necessary. "When leadership communicates a serious issue with an appreciation for people's good sense and intelligence, you can change those numbers."

Whether a detailed climate agreement or general framework will emerge from climate change negotiations in the near future remains uncertain. However, even if an agreement is reached, the dialogue on climate change will not end in Copenhagen. International cooperation, as well as efforts to obtain domestic support at home, will be ongoing through 2012 and beyond. Leaders' knowledge of the public's awareness will be instrumental as they continue to develop communication and education strategies to inform the public about decisions regarding international climate agreements and domestic measures.

The following is excerpted from "A Heated Debate: Global Attitudes Toward Climate Change," *which appears in the Fall issue of Harvard International Review on newsstands now.*

Gallup Survey Report (2008); By Anita Pugliese and Julie Ray

2.4 Causes of Climate Change

Factors that can shape climate are climate forcings. These include such processes as variations in solar radiation, deviations in the Earth's orbit, mountain-building and continental drift, and changes in greenhouse gas concentrations. (Houghton, *et al*, 2003)

There are a variety of climate change feedbacks that can either amplify or diminish the initial forcing. Some parts of the climate system, such as the oceans and ice caps, respond slowly in reaction to climate forcing because of their large mass. Therefore, the climate system can take centuries or longer to fully respond to new external forcings. (M. Hulme, 2003)

2.4.1 Plate Tectonics

Over the course of millions of years, the motion of tectonic plates reconfigures global land and ocean areas and generates topography. This can affect both global and local patterns of climate and atmosphere-ocean circulation. (Abbot, C.G, 1963)

The position of the continents determines the geometry of the oceans and therefore influences patterns of ocean circulation. The locations of the seas are important in controlling the transfer of heat and moisture across the globe, and therefore, in determining global climate. A recent example of tectonic control on ocean circulation is the formation of the Isthmus of Panama about 5 million years ago, which shut off direct mixing between the Atlantic and Pacific Oceans.

2.4.2 Solar Output

The sun is the predominant source for energy input to the Earth. Both long and short-term variations in solar intensity are known to affect global climate. The variation in solar activity during the last several centuries has been based on observations of sunspots and beryllium isotopes. (Hoyt, D.V, 1997)

Over the past approximately 4 billion years, the energy output of the sun has increased and atmospheric composition changed, with the oxygenation of the atmosphere being the most notable alteration. The luminosity of the sun will continue to increase as it follows the main sequence. These changes in luminosity, and the sun's ultimate death as it becomes a red giant

and then a white dwarf, will have large effects on climate, with the red giant phase possibly ending life on Earth. (Adger, S.N, 2003)

2.4.3 Orbital Variations

Slight variations in Earth's orbit lead to changes in the seasonal distribution of sunlight reaching the Earth's surface and how it is distributed across the globe. There is very little change to the area-averaged annually-averaged sunshine; but there can be strong changes in the geographical and seasonal distribution. The three types of orbital variations are variations in Earth's eccentricity, changes in the tilt angle of Earth's axis of rotation, and precession of Earth's axis. Combined together, these produce Milankovitch cycles which have a large impact on climate and are notable for their correlation to glacial and interglacial periods, their correlation with the advance and retreat of the Sahara, and for their appearance in the stratigraphic record. (NRC, 1994)

2.4.4 Volcanism

Volcanism is a process of conveying material from the crust and mantle of the Earth to its surface. Volcanic eruptions, geysers, and hot springs, are examples of volcanic processes which release gases and/or particulates into the atmosphere. Eruptions large enough to affect climate occur on average several times per century, and cause cooling (by partially blocking the transmission of solar radiation to the Earth's surface) for a period of a few years. (S. Huq, 2003)

Volcanoes are also part of the extended carbon cycle. Over very long (geological) time periods, they release carbon dioxide from the Earth's crust and mantle, counteracting the uptake by sedimentary rocks and other geological carbon dioxide sinks. According to the US Geological Survey, however, estimates are that human activities generate more than 130 times the amount of carbon dioxide emitted by volcanoes. (Camberlin. P, 2001)

2.4.5 Ocean Variability

The ocean is a fundamental part of the climate system. Short-term fluctuations (years to a few decades) such as the El Niño–Southern Oscillation, the Pacific decadal oscillation, the North Atlantic oscillation, and the Arctic oscillation, represent climate variability rather than climate change. On longer time scales, alterations to ocean processes such as thermohaline circulation

play a key role in redistributing heat by carrying out a very slow and extremely deep movement of water, and the long-term redistribution of heat in the world's oceans. (Bradshaw. B,H, 2003)

2.4.6 Human Influences

Anthropogenic factors are human activities that change the environment. In some cases the chain of causality of human influence on the climate is direct and unambiguous (for example, the effects of irrigation on local humidity), whilst in other instances it is less clear. Various hypotheses for human-induced climate change have been argued for many years. Presently the scientific consensus on climate change is that human activity is very likely the cause for the rapid increase in global average temperatures over the past several decades. Consequently, the debate has largely shifted onto ways to reduce further human impact and to find ways to adapt to change that has already occurred. (DMCN Workshop, 1999)

Of most concern in these anthropogenic factors is the increase in CO_2 levels due to emissions from fossil fuel combustion, followed by aerosols (particulate matter in the atmosphere) and cement manufacture. Other factors, including land use, ozone depletion, animal agriculture and deforestation, are also of concern in the roles they play - both separately and in conjunction with other factors in affecting climate, microclimate, and measures of climate variables. Most of the evidence in the last century supports the causes to be anthropogenic in nature. (IPCC, 1997)

2.5 Physical Evidence for Climate Change

Evidence for climatic change is taken from a variety of sources that can be used to reconstruct past climates. Reasonably complete global records of surface temperature are available beginning from the mid-late 1800s. For earlier periods, most of the evidence is indirect, meaning climatic changes are inferred from changes in proxies, indicators that reflect climate, such as vegetation, ice cores, dendrochronology, sea level change, and glacial geology. (NRC, 1999)

Climate change in the recent past may be detected by corresponding changes in settlement and agricultural patterns. Archaeological evidence, oral history and historical documents can offer insights into past changes in the climate. Climate change effects have been linked to the collapse of various civilizations. (NRC, 1994)

2.6 Effects of Climate Change on Communities

To assess the potential effects of climate change on communities, it is necessary to consider both the sensitivity and vulnerability of populations to changes in temperature, rainfall, humidity, storminess, and so on. Vulnerability is a function both of the changes to exposure in climate and of the ability to adapt to that exposure. (Houghton, J.T, 1996)

2.6.1 Natural Disasters

Climate change will increase the risk of both floods and droughts. Ninety percent of disaster victims worldwide live in developing countries, where poverty and population pressures force growing numbers of people to live in harm's way, like on flood plains and on unstable hillsides. Unsafe buildings compound the risks. The vulnerability of those living in risk-prone areas is perhaps the single most important cause of disaster casualties and damage. (Callander, B.A 2001)

2.6.2 Water Quality and Quantity

Human health depends on an adequate supply of potable water. By reducing fresh water supplies, climate change may affect sanitation and lower the efficiency of local sewer systems, leading to increased concentrations of pathogens in raw water supplies. Climate change may also reduce the water available for drinking and washing. In developed countries, the anticipated increase in extreme rainfall events, which may be associated with the outbreaks of diarrheal diseases, may overwhelm the public water supply system. Flooding is likely to become more frequent with climate change and can affect health through the spread of disease. (Meira Filha, L.G, 1998)

2.6.3 Food Security

Current assessments of the effects of climate change indicate that some regions are likely to benefit from increased agricultural productivity while others may suffer reductions, according to their location and dependence on the agricultural sector. The IPCC has reviewed the results of many modeling experiments that project future changes in crop yields under climate change.

Climate change may increase yields of cereal grains at high and mid-latitude areas but may decrease yields at lower latitudes. The world's food system may be able to accommodate such regional variations at the global level, with production levels, prices, and the risk of hunger being relatively unaffected by the additional stress of climate change. However, populations in isolated areas with poor access to markets may still be vulnerable to locally important decreases or disruptions in food supply. (Harris, N. 2003)

2.6.4 Social Dislocation

The growth in the number of refugees and displaced persons has increased markedly. Refugees represent a very vulnerable population with significant health problems. Large-scale migration is likely in response to flooding, drought, and other natural disasters. Both the local ecological disturbance caused by the extreme event and the circumstances of population displacement and resettlement would affect the risk of infectious disease outbreaks. Even displacement due to long-term cumulative environmental deterioration, including sea level rise, is associated with such health impacts. (Katternberg, A. 2001)

2.6.5 Infectious Diseases

Vector-borne diseases are transmitted by insects (e.g., mosquitoes) and ticks that are sensitive to temperature, humidity, and rainfall. Climate change may alter the distribution of important vector species, and this may increase the risk of introducing disease into new areas. Temperature can also influence the reproduction and survival of the infective agent within the vector, thereby further influencing disease transmission in areas where the vector is already present. Malaria is on the increase in the world at large, but particularly in Africa. (Houghton, et al, 2002)

In several locations around the world, malaria is reported in the twenty-first century at higher altitudes than in preceding decades, such as on the mountain plateaus in Kenya. The reasons for such increase have not yet been confirmed but include population movement and the breakdown in control measures. Climate change may in future contribute to the spread of this major disease in highlands and other vulnerable areas. The season transmission and distribution of many diseases that are transmitted by mosquitoes (dengue, yellow fever), sandflies (leishmaniasis),

and ticks (Lyme disease, tick-borne encephalitis) may also be increased or decreased by climate change. (Davidson, et al, 2001)

2.7 International Interventions on Climate Change

There are two responses to global climate change:

- Mitigation. Intervention or policies to reduce the emissions or enhance the sinks of greenhouse gases. The current international legal mechanism for countries to reduce their emissions is the United Nations Framework Convention on Climate Change (UNFCCC).
- Adaption. Responses to the changing climate (e.g., acclimatization in humans) and policies to minimize the predicted effects of climate change (e.g., building better coastal defenses)

Due to the profound consequences of climate change, coupled with the fact that the culprits for the changes are well known, there has been an array of world-wide efforts geared towards tackling the effects of climate change and global warming. The first of such being 'The Toronto Conference' in Canada that led to the setting up of the Intergovernmental Panel on Climate Change (IPCC) by both the World Meteorological Organization and UNEP.

Charged with the role of examining scientific evidence and reporting back to world leaders, the IPCC recommended a raft of proposals that led to the Rio Earth Summit in 1992 which was a high profile meeting aimed at addressing the climate change problem. At this meeting, the United Nations Framework Convention on Climate Change (UNFCCC) was adopted by the signatories. (Howes *et al*, 1997)

The above was essentially a commitment to stabilize greenhouse gases in the atmosphere to pre-1990 levels by the year 2000, a commitment that was reinforced by the Conference of Parties (CoP-3) in 1997 that was held in Japan and dubbed the *Kyoto Protocol*. The above set targets for six greenhouse gases and an overall target, rather than individual targets for high emitting countries was set. (ENDS, 1997)

Agreed upon, was that developed countries cut their emissions by 5.2% by the year 2012 with the United States agreeing to a 7% reduction while the European Union committed to an 8% reduction (ENDS, 1997). In November 1998, the fourth meeting in Buenos Aires (CoP 4) was to decide on the implementation strategy for the Kyoto Protocol. Instead, most of the decisions were left unresolved and it is unclear whether enough has been done to stabilize the climate (Pearce, 1998).

With large emitters like the United States, China and Australia still refusing to cut their own emissions until certain key developing countries accept some emission targets, the whole policy process was in danger of stalling and it looked increasingly likely that we would be unable to stop climate change (Pearce, 1999). True to the above statement, the Kyoto Protocol failed to a large extent in curbing GHG emission.

With the world leaders currently focusing on a post-Kyoto agreement, like recently witnessed in Copenhagen, the onus falls on the poor and equally vulnerable countries of Africa to stand up and be counted in the climate debate. The developed countries will not solve their problems arising from their activities that fuel climate change but will at best agree to mitigate some effects based on the principle of differentiated responsibilities as currently argued in the international forum by those countries most responsible (Pearce, 1999).

CHAPTER THREE
STUDY AREA AND METHODOLOGY

3.1 Introduction

In this chapter, the study was mainly looking at the methods by which the investigation was to be carried out. It entailed the description of the study area, climate, study population, research design, sampling techniques and sample size, data collection procedures, data collection instruments and data analysis design.

3.2 Description of Study Area

Trans-Nzoia District is an administrative district of Rift Valley Province, Kenya. It is located between the Nzoia River and Mount Elgon and its centre is the town of Kitale.

The district is very expansive covering approximately 34,000 sq km in size and traversing different agro-ecological zones comprising of both fertile highlands and extensive forests.

Historically the area has been inhabited by the Kalenjin people. After independence many of the farms vacated by white settlers were bought by individuals from other ethnic groups in Kenya.

The district has three constituencies:

- Cherangani Constituency
- Kwanza Constituency
- Saboti Constituency

Table 3.2: Local Authorities (Councils)

Authority	Type	Population	Urban Population
Kitale	Municipality	86,055	63,245
Nzoia	County	489,607	0
Total	-	575,662	63,245

Source: 1999 Census

Table 3.2.1: Administrative Divisions

Division	Population	Urban Population	Headquarters
Central	147,992	42,884	Kitale
Cherangany	52,974	0	Cherangany
Endebess	61,481	0	Endebess
Kaplamai	89,858	0	-
Kiminini	64,685	0	Kiminini
Kwanza	88,727	0	Kwanza
Saboti	69,945	0	Saboti
Total	**575,662**	**42,884**	-

Source: 1999 Census

3.2.2 Climate

Although Trans Nzoia's varied environments experience a wide variety of climatic conditions, the temperature remains comfortably warm all year round. Much of Trans Nzoia experiences heavy rainfall from March to May and, to a lesser extent, from October through December therefore indicating a *bi-modal* cli mate pattern. The best time for most outdoor activities, including safari and mountain climbing, is during the dry season (June-September). (Kenya Meteorological Department, 2008)

3.3 Study population

The study targeted agricultural and pastoral communities from five of the seven administrative divisions of Trans Nzoia District. In order to achieve maximum objectivity, emphasis was placed on interviewing households comprising farmers, livestock keepers and forest dwelling communities. Others targeted were environmental officers, agricultural extension officers, meteorological staff and local NGO technical support staff. The above were preferred since environmental variations such as climatic changes have a direct effect on many aspects of their social welfare. International organizations working in collaboration with government technocrats were also interviewed.

3.4 Research Design

The study used both descriptive and analytical research designs. The following were utilized by the researcher because they offered very effective ways of research presentation during the discussion on the findings of the research study. The research study was survey-based on both quantitative and qualitative data analysis. At the end of the research period, data for all divisions was analyzed and consolidated into one comprehensive report.

3.5 Sample Size and Sampling Techniques

The study population of the five administrative divisions of Central, Cherangany, Endebess, Kwanza and Saboti is 421,119 (KBS, 1999). Participants in the study area were drawn from 70 households (respondents) (n = 70) who were community members (farmers, pastoralists, local community leaders). Individual government officials who were interviewed were 15 (n = 15), local non-government organizations were 10 (n = 10) and 5 participants were from international organizations (n = 5). In total there were one hundred respondents (N = 100). The sample size was calculated using a formula $\mathbf{n} = N/ (1+ (N * e^2))$ where **n** is representing sample size, N is the total population and **e** represents the level of statistic significance set.

Table 3.5: The summary of the study population

Participants	Estimated population	Targeted sample size (n)
Community members	70	70
Governmental officials	15	15
Local NGOs	10	10
International Organizations	5	5
Total (N)	**100**	**100**

The researcher used systematic random sampling to select the representatives of the community members such as households comprising of farmers, pastoralists and local leaders because it was considered to have less bias and was of reasonable time convenience, while purposive sampling technique was used to select interviewees from NGO's/CBO's, Government Departments and International Organizations since it ensured that only pre-determined and chosen respondents were approached and hence it resulted in the acquisition of relevant, correct and adequate information. Sampling by use of interviews involved the 20 respondents in each division under study.

3.6 Data Collection Methods

The recommendation letter obtained from the Dean of the School of Engineering and Applied Sciences was issued to divisional leaders. In each division, a sample size of one hundred respondents was selected into which primary and secondary sources of data were put in focus during data collection. The primary data came from the researcher's personal observation of the visible features of phenomena on the field of study.

Also, interviews of specific target groups, use of questionnaires as well as focus group discussions were put into practice. Secondary data was obtained through the reviewing of other scholarly materials o n the same topic with authority for the same being derived from the relevant agencies involved like the National Environment Management Authority (NEMA).

3.7 Data Collection Instruments

The research required cameras to facilitate photography of the observable features which were later used for data analysis and interpretation. Questionnaires were also used in collecting the non-observable aspects of the study. These questionnaires were structured and delivered to all selected respondents in the areas of study. Other methods used included interviews, literature reviews and focus group discussions.

3.7.1 Questionnaires

Questionnaires were designed in line with the topic and objectives of the study and included both open and closed-ended questions that were administered to households comprising of local farmers, pastoralists and local community leaders. This instrument offered a very efficient and convenient way by which respondents were given time to consult and read the documents

before answering the questions. It also minimized the chances of acquiring biased answers since respondents were given adequate time and privacy to write what they would otherwise have found hard to do in the researcher's presence.

3.7.2 Interviews

Interviews were mostly used to supplement questionnaires and came in to guide on acquiring insights into the attitudes and cultures of the respondents that might be responsible for abating the effects of climate change thereby increasing challenges facing adaptation and mitigation measures. The interviews were done on a face to face basis using structured interview guides to guide the process and only involved selected interviewees who included agricultural extension officers, meteorological department analysts, NGO's and International Organization technical support staff. The above was also greatly aided by the use of a researcher's checklists for the above interviewed groups.

3.7.3 Observation

This involved actual fact finding on the ground to ascertain whether responses achieved from interviews and questionnaires held out in the field. It was very important since researchers are not always given accurate information by target groups due to fear of reprisals from the society. Also, some cultures tend to be very secretive and cautious of outsiders intentions.

3.7.4 Focus Group Discussions

This method or technique was conducted with the help of an interview guide since it enabled respondents to give instant answers. Two (2) groups comprising of 8 participants were chosen. The participant included retired government officers, teachers of science subjects, farmers, students and environmental officers. Data collected was easily edited since the researcher was able to hear what the respondents were communicating. Through the above, the researcher was saved from misinterpretation of questions since he could rephrase the question incase it was not understood or answered to satisfaction thereby acquiring relevant information.

3.7.5 Literature Review

This inv olved infer ence to scholarly articles and journals pertaining to the study topic on climate change and its effects on communities who are usually vulnerable and unaware of their

predicament. Some of the most reliable sources for this data was the internet, maps, relevant government documents, NGOs and other educational institutions in the study areas.

3.8 Data Processing and Analysis

Coding techniques of data analysis were used to separate the insignificant elements of the findings from the significant ones found in the same literature. Through editing, data was rearranged to make sure that the collected information was both complete and systematically stored.

Analyzing data using both Qualitative and Quantitative methods was put into consideration whereby the research objectives and research questions were used as guides during analysis. Using computer analytical programmes such as Microsoft Excel software, the quantitative data collected was then presented in frequency form, as percentages, pie charts and tables while qualitative data utilized descriptive techniques of data analysis.

3.9 Limitations of the Study

Since the scope of the study was very big in terms of the size of the geographical area to be covered, project funding to meet travel expenses and logistics relating to the detailed nature of the assessment under study presented a challenge to the undertaking.

The researcher anticipated encountering interviewees who don't speak either Kiswahili or English and therefore had to rely on local translators which limited interaction and may have result into logistical errors or misinterpretation of facts. Issues of coverage in terms of encompassing the whole target population also present a great challenge.

Given the nature of the topic under study, access to vital secondary data like weather charts dating back many years from the District Meteorological Department also presented a big challenge since the department is not computerized and therefore involved shifting through piles and loads of paperwork in search of data.

CHAPTER FOUR
FINDINGS, DATA ANALYSIS AND DISCUSSIONS

4.1 Introduction

This chapter presents and interprets the findings of the study carried out by the researcher in the field on the topic under investigation. The data from completed questionnaires was analyzed using percentages and presented in form of figures, tables and charts. Comparative analysis in relation to similar research done on the topic by the Gallup Group was also done.

4.1.1 Summary of the Respondents

The study population comprised seventy (n=70) respondents who were drawn from different households, which was the basic sampling unit and they included community members such as farmers, pastoralists, local leaders, students and workers including casual and skilled laborers. Government officials interviewed were fifteen (n=15) and they included agricultural extension officers, meteorological staff and teachers while local non-governmental organization respondents were ten (n=10) and finally international organization respondents were five (n=5) providing a total sample size of one hundred respondents **(N=100).**

Table 4.1.1: Summary of the Respondents

Respondents	**Sample Size (n)**	**Percentage (%)**
Community Members (households, farmers, pastoralists, local leaders)	70	70%
Government Officials (agricultural extension officers, meteorological staff)	15	15%
Local NGO Staff	10	10%
International Organizations	5	5%
Total (N)	**100**	**100%**

Source: Primary Data

Figure 4.1.1 Summary of the Respondents

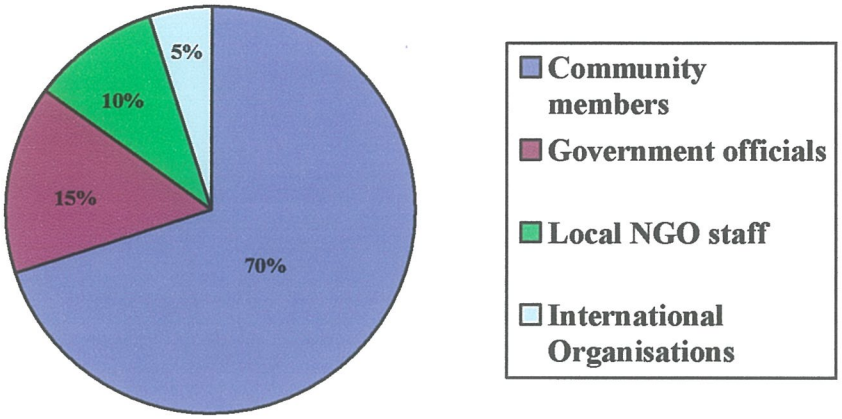


Figure derived from table 4.1.1

Source: Primary Data

The figure above shows the percentages of respondents interviewed in the field survey carried out by the researcher and forms the basis on which data received was analyzed in order to gauge the level of awareness on climate change in the study area in relation to the effects that the same has had on livelihoods and socio-economic activities of the respondents.

4.2 Communities' awareness on Climate Change, its Causes and Observable Evidences

The first question posed to the respondent's, phrased in the form *"What is climate change according to you?"* revealed a huge gap in the knowledge on climate change and its effects by a majority of the respondents interviewed.

Although almost all of the government officials, local non-governmental organization staff and international organization technical staff respondents interviewed possessed adequate knowledge on the subject, the same cannot be said of the larger segment of the Trans Nzoia population. The research revealed a general lack of knowledge on the subject with 66% of the respondents not being knowledgeable compared to 44% who are aware of the climate change issue.

Indigenous knowledge shapes the perceptions of majority of the respondents who are not aware of the climate change issue with a breakdown of the 66% revealing that about 48% of them attribute the changing climatic weather patterns to traditional or cultural symbolism and occurrences thereby detaching the subject completely from its scientific basis which formed the core component of this research undertaking.

Respondent Agnes Kemunto, 43 years old and a farmer from Kaisagat village, 25km north-west of kitale, an area classified as upper midland in terms of agro-ecological zoning, had this to say when posed the climate change question;

"Climate change is lack of rainfall that has gripped trans nzoia district since the early 1990's and it was due to the community harvesting wheat during the period of mourning in remembrance of the great chief Koitalel Arap Samoei of the nandi sub-clan which went against cultural norms and resulted into our great misfortunes"

Such responses, even though touching on some basic meaning of global climate change which is characterized by the persistent variation in precipitation patterns over time, completely made no correlation to the increase in global temperatures occasioned by rising levels of carbon dioxide in the atmosphere and were therefore taken to refer to the unaware respondents to the question that was posed.

Ronald Barsito, 66 years, a community spiritual elder from Koitalel Village which is in eldoret north also possessed quite a unique understanding of the climate change phenomenon when it came to answering the question through a translator as he was a very senior citizen in terms of age. His response was to the effect that;

"The change of weather the researcher is referring to is indeed a punishment on the community by the ancestors occasioned by the change in community values attributed to the young generation who discarded traditions such as offering of sacrifices and disrespect to observe strict cultural values hence resulting into misfortune in terms of either extended droughts or short heavy rains"

Diversity among different geographical zones that Trans Nzoia Disrict traverses, had responses from the northern frontier areas of Kapenguria which comprises pastoralist communities who

reside in semi-arid conditions as regarding climate change referring to the following according to 33 year old Emmanuel Majak;

"Climate change is the increase in hot and dry conditions which are caused by the sun's increasing intensity that has continued to make water sources dry year after year making rainfall seasons to become less and less compared to when I was a young boy and rainfall was a lot leading to plenty of water sources in Kapenguria"

Such responses as the one above made significant correlation of indigenous understanding of climate change and its scientific basis since it touched on the fundamental characteristics of the phenomenon and such were classified as the respondents who were slightly aware of climate change issues. Arnold Wasilwa, a mechanic supported the above through his response below;

"Climate change is the absence of rain that is caused by the process of building many industries and roads therefore cutting trees that usually attract rainfall hence making the rainy seasons to dwindle and instead leads to the dominance of the current drought conditions"

Salim Kilimo, 47 years from Elgon View in eldoret town appeared totally unaware since instead of relating climate change to being a worldwide phenomenon caused by scientific variables such as increase in GHG emissions and the destruction of the environment such as deforestation even after being given hints and pointers opted to explain himself thus;

"As a born again Christian, I believe God is punishing Kenya by having brought drought due to the post election violence that saw many innocent people die as a result of greed and lust for power, national repentance is the only way out of this predicament"

More forthright and honest respondents like Peter Mailu, 39 years of age and a maize roaster in Saboti who was totally unaware had this as his response;

"I am sorry I cannot be of any help to you about the issue you are asking me, maybe my neighbor who has gone to school till senior four can be well placed to answer your question concerning that topic"

Similar to findings by Gallup, responses such as the one above greatly show that awareness on climate change varies with educational attainment, as the level of education serves as the single best correlate of awareness and knowledge across different regions. As seen or evidenced above

in the sampled responses, Adults with eight years of education or less are least likely to be knowledgeable on climate change issues.

Awareness is significantly higher among those with nine to fifteen years of education while nearly all adults--94%--with a four year college/university degree reported awareness of climate change; however, even among the above educated segment of the interviewed respondents, slightly more than half possessed highly technical knowledge on the subject.

Majority of the 44% of the study population that was aware of climate change, its causes and observable evidence in their respective localities was found among the government officials, local NGOs and international organizations that together accounted for 36% of those aware while community members accounted for 8%. Almost the entire 66% of those unaware of climate change and its causes were drawn from the community members.

Arnold Ochieng of the Kenya Meteorological Station in Kitale town had a very brief and precise response to the question posed, according to him;

"Climate change is the change in average weather over time and over a region. Climate change includes changes in temperature, wind patterns and precipitation"

Dr. Tom Schweiger of the UNEP Disaster Preparedness and Early Warning Department based in Eldoret town has this to say;

"Climate change is any change in global temperatures and precipitation over time due to natural variability or to human activity that results in the increase of radiation trapping GHG gases in the atmosphere such as carbon dioxide and methane"

SCC-VI Agro forestry project manager in Kitale, Mr. Fred Marani also had this very useful input as far as what climate change is;

"Climate average condition of the atmosphere near the earth's surface over a long period of time, taking into account temperature, precipitation, humidity , wind , barometric pressure, and other phenomena"

Similar to Gallup's Analysis, the research findings strongly suggest that the relationship between educational attainment and awareness on climate change is lowest among adults with no formal education and increases dramatically with level of education.

4.2.1 Gauging Awareness of Climate Change in Trans Nzoia

Respondents	Sample Size (n)	% Aware	% Unaware
Community Members (households, farmers, pastoralists, local leaders)	70	36	64
Government Officials (extension officers, meteorological staff)	15	78	22
Local NGO Staff	10	84	16
International Organization Officials	5	100	0

Based on surveys in 7 administrative divisions in Trans Nzoia District

Source: Primary Data

4.2.2 Educational Level and Climate Change (N=100)

Level of Education	% of Respondents Aware	% of respondents Unaware
Up to 8 Years of Education	18	78
Up to 15 Years of Education	37	63
4 Years or more of University	58	42

Based on surveys in 7 administrative divisions in Trans Nzoia

Source: Primary Data

Despite the glaring lack of knowledge on climate change and its causes as seen from the quoted responses attained from the field, the sample population showed a very high level of awareness when it came to pointing or highlighting the observable evidences of climate change in the study area. The above is due to the fact that with the changing weather patterns, some physical features have been affected that are very noticeable even to those without any formal education.

Respondent Anne Wakio, a primary school teacher from Kesses which is in Endebess Division pointed out the following as evidence that climate change was actually occurring in the study area;

"River Nzoia used to get so full during the rainy season like now that it would usually burst it's banks and water our farms downstream leading to abundant harvests but as you can see now, there is barely water flowing in it to enable us draw enough amounts for both domestic and agricultural use"

Similar sentiments were expressed by those living in Cherangany which occupies a forested zone encompassing the heavy thicketed Cherangany Forest and Mt. Elgon. Robert Kip'ngetich had this to say;

"This change of weather has affected many features of this area including the loss of vegetation cover that would span almost the entire Eastern part of this region and extend into the forest. It is now totally dry with even the streams that were there now have disappeared"

4.3 Effects of Climate Change on Socio-Economic Activities of Communities

The research found out that climate change effects have had dire and serious consequences on the livelihoods and socio-economic activities of the communities in Trans Nzoia District. Their opportunities for poverty eradication and economic advancement have been severely constrained despite the fact that the region is very potentially resourceful in terms of agricultural productivity and other industry related activities such as forestry and fishing.

The study found out that the negative effects experienced are expressed mainly in terms of deprivation of the respondents every day economic earnings that results from a reduction in the amount of trade in either crops, animals reared such as cows and others such as fish and timber sales that are depended upon by those engaged in forestry activities.

Table 4.3.1: Socio-Economic Activities Practiced by Respondents in Trans Nzoia

Economic Activity	Sample Respondents (n)	Percentage (%)
Farming	36	36
Pastoralism	28	28
Fishing	16	16
Forestry	4	4
Casual Labor	6	6
Skilled/Professional Work	10	10
Total (N)	**100**	**100**

Based on surveys in 7 administrative divisions of Trans Nzoia

Source: Primary Data

Figure 4.3.1 Effects of Climate Change on Socio-Economic Activities of Communities'

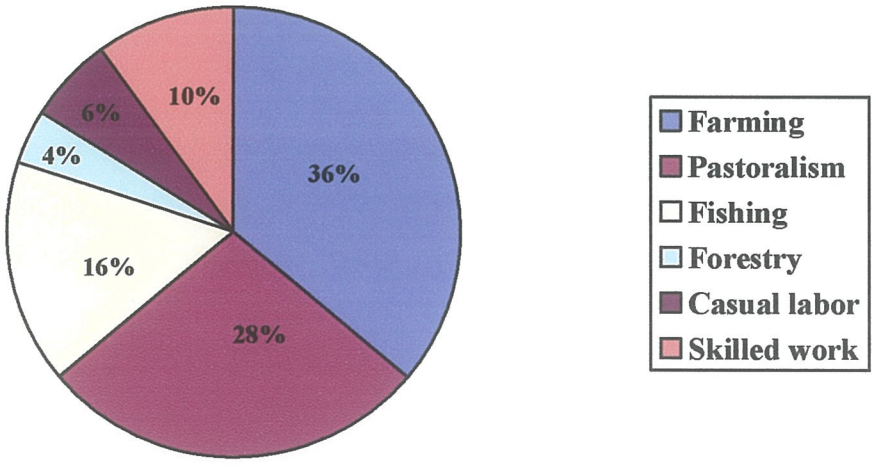


Figure derived from table 4.3.1, *Source: Primary Data*

According to the pie chart above, the result found out that climate change has had adverse socio-economic effects on activities that are mostly dependent on the natural weather regimes in terms of temperature and precipitation such as farming which has been mostly affected, followed closely by Pastoralism that is also highly susceptible to changes in precipitation as compared to other activities that indirectly rely on weather such as fishing, forestry and casual/skilled labor.

4.3.2 Farming

Farming is the most predominant socio-economic activity practiced by the communities in Trans Nzoia district. Slightly less than half of the respondents interviewed indicated depending solely on the growing of crops for both subsistence and commercial purposes in order to earn their living. The sensitivity and vulnerability of the above activity to changes in temperature, rainfall and humidity has seen the respondents engaged in it suffer great loss and become prone to food insecurity due to climatic changes. Majority of the interviewed respondents possess a great awareness of the effects that the variations in climate has subjected them to.

Grace Moraa, a single mother in Kaplich village in Kiminini Division has seen her fortunes reduce significantly thereby making it hard for her to cater for the needs of her six children who are dependent on her for their upkeep. She expressed the above thus;

"Ever since the weather patterns started changing and becoming unreliable, it has greatly affected my farms on which I grow a variety of crops especially maize for sale to the local National Produce and Cereals Board that has been enabling me earn significant amounts of money to cater for my large family. Nowadays I barely get enough to sustain us due to the drought and even two of my children have had to drop out of school and look for work"

She is not alone on the above predicament since her sentiments were echoed by all other respondents dependent on farming as the mainstay of their socio-economic livelihoods. Anita Mathenge, a coffee grower on the slopes of Mt. Elgon said;

"This climate change issue has really affected my business of growing coffee in a most negative way. Long periods of drought intermitted with short unpredictable rainy intervals have led to loss of crop yields that dry up and go to waste. I have now decided to uproot all the coffee

bushes and instead plant more drought resistant crops that cost less in terms of labor and fertilizer investment to avoid further losses"

Climate change has not even spared the most vulnerable population who practice farming for their subsistent survival as indicated in the below response received from Mr. Jackson Korir, who is a handicapped single father of two owning a 1 acre farm in Kwanza division;

"The change in weather seasons have seen my family starve to a point where my sons now carry out manual labor in the town in order to sustain me since I am handicapped and would depend on the food we got from the farm that was enough for our daily needs but is now far less than what we can survive on"

4.3.3 Pastoralism

Pastoralism was another economic activity that respondents in the study area hugely dependent on and were likewise aware of the effects that climate change had on their socio-economic welfare. The effects of climate change on the above was mainly expressed in relation to water quality and quantity that has been on a steady decline in recent years owing to the dry conditions experienced in the district.

Respondent David Aukot from Wareng Location that is situated in Kiminini administrative division that is a largely pastoralist area has this to say;

"The climate change issue has resulted into great suffering for the people in this area. As you know, we are mainly dependent on cattle rearing for both our local needs and as an economic activity through selling milk to co-operative societies and meat to slaughter houses who give us very good money for our cows. But with the current dry weather, pastures have dried and water is scarce leading to death of many herds thereby forcing us to sell them at low prices thereby incurring losses in order to avoid further calamity"

The story is almost similar among all the respondents from the pastoralist communities who express climate change effects to pose a huge threat to themselves and their families based on the seeming vulnerability posed to them, a fact that is consistent with Gallup's Analysis on awareness on climate change in relation to the threat it poses to people's lifestyles. Ekuru Majal who owns a very large herd of cattle said;

"The survival of our community depends on availability of rain that leads to vegetation for our cattle and lots of water from the rivers and streams that supply our villages. Time and again, during droughts periods we loose lots of revenue from death of many herds as is currently the case now since this long dry period that has extended well above its normal duration started"

Other more well established ranchers like settler Tim Wolf who owns a vast ranch in the study area and rears cattle using latest modern technology and methods had the following to say;

"My fortunes of late have been severely affected by occurrences I directly attribute to climate change that has resulted into a major shift in the bi-modal weather patterns that used to be very reliable thereby enabling planning and realization of profits as compared to now that weather patterns are erratic and result in unpredictability that is very bad for investment since the risks and uncertainties involved are too big to contemplate"

4.3.4 Fishing and Forestry

The above two economic activities also had respondents interviewed attributing them to be severely affected by climate change variations thereby leading to a downward trend in their socio-economic welfare in recent years.

SCC-Vi and Kenya Forestry Service personnel interviewed also had very relevant information concerning the effects of climate change on the above two activities. Bernard Ochieng of Kenya Forestry Department said;

"As an officer concerned with forestry activities in relation to communities harvesting of timber to meet their energy needs in a sustainable manner, I can say that climate change has posed the greatest threat to sustainable forest management through increasing communities dependence on forestry resources in the face of unpredictable weather patterns that forces people to over-harvest forest products"

On the above note, the department has been forced to impose a nine year logging ban on timber products in Cherangany Forest due to problems of over-harvesting that threatens tree replenishment levels posing the dangers of deforestation.

On the other hand, a good proportion of Trans Nzoia residents rely on aquaculture practiced through ponding and funded by SCC-Vi based at Kitale in the Central Administrative Division. The above supplements' fishing that occurs in the numerous rivers that the study area has been naturally endowed with. SCC-Vi administrator Charles Odegi in charge of the outreach program had the following opinion;

"Climate change has had mixed fortunes for the fishing industry in this area as abundant harvests are realized during floods and long rainy periods leading to profits for the communities involved in the activities while severe stress is also experienced during the dry season leading to losses being incurred in the process"

4.4 Effects of Climate Change on the Livelihoods of Communities

Respondents interviewed who are engaged in either casual labor or other careers in government establishments or private business, have experienced climate change effects on a more personal household level as established during the research study.

4.4.1 Natural Disasters

The high poverty levels and population pressure has forced growing numbers of people in Trans Nzoia to live in harm's way especially on flood plains and unstable hillsides. The above scenario has resulted in the communities bearing huge disaster casualties and damages.

Anne Nyakio, a respondent from the hilly slopes of Mt. Elgon has personally suffered great loss due to the above as narrated below;

"Lack of enough arable land forced my family to build our house on the slopes of the hills but last year a landslide caused by a heavy downpour buried our house killing my three children and husband thereby leaving me all alone in this world with no hope for the future as there is nothing to look forward to in life anymore"

4.4.2 Water Quality and Quantity

Climate change has reduced fresh water supplies leading to scarcity of available water for domestic use such as drinking and washing. Sylvia Amattah, a business woman from Munyaka in Eldoret had the following to say;

"Water for drinking and washing has become a real problem in the area of late. Water rationing by the local authorities who blame the situation on lack of rain forces us to commute long distances in search of the vital commodity thereby incurring huge expenses just to get low quality water unsafe for consumption"

Similar sentiments were expressed by almost all respondents who said the availability of freshwater had been affected by climate change.

4.4.3 Social Dislocation

The growth in the number of internally displaced people has increased dramatically in Trans Nzoia district therefore representing a very vulnerable population suffering significant health problems. Large-scale migration of mostly pastoralist communities is mainly due to flooding, droughts and other natural disasters caused by extreme weather events resulting from climatic changes.

Sampled responses varied significantly across the study area with Martin Lemama, a pastoralist currently facing eviction from Embobut Forest which is a Forest Reserve saying;

"I have travelled long distances with my cattle looking for pastures to graze due to harsh dry conditions being experienced in my area of residence that has been experiencing lack of rainfall and natural vegetation especially grass thereby leading to death of cattle in large numbers"

The above scenario of people being displaced as a result of travelling from their usual areas of residence to look for better opportunities is very widespread in the study area.

4.4.4 Infectious Diseases

The above presented a very unique effect of climate change as most respondents especially community members acknowledged the increasing frequencies and severity of occurrence of such vector-borne diseases transmitted by insects such as mosquitoes and ticks but could not at all relate them to climate change. Responses such as the one observed below from Mayanga Arnold, a community elder support the above fact;

"Malaria has really increased and become more serious nowadays leading to many deaths especially of young infants. I think the cause is the large bushes that have resulted from

many young people going to towns to look for jobs therefore leaving us, the old parents alone and the very young ones who cannot take care of such tasks thereby resulting into more breeding sites for mosquitoes that spread malaria"

Despite the above lack of awareness among community members, some respondents had quite sufficient knowledge of the relationship between the changing climatic patterns and increased diseases prevalence such as Michael Otieno, a public health official who had this to say when interviewed;

"We are currently promoting use of treated mosquito nets to every household to curb the spread of malaria that has become very rampant in this area due to changing temperatures that has offered conducive habitats for disease causing vectors to thrive"

More established organizations such as the Kenya Meteorological Station have more clear observations such as the one below sampled from Dr. Eric Matsanga of the Research and Development Department;

"The reasons for such increases in tropical disease spread on the mountain plateaus of Trans Nzoia can be attributed to population movements and breakdown of control measures since the season of transmission and distribution of many infectious diseases such as dengue fever and encephalitis have been made severe by climate change effects"

Regardless of the above variance in opinions about the causes of the increased disease prevalence, all respondents interviewed were in agreement that the effects were currently being felt and experienced in the study area.

4.5 Government and International Organization Programmes on Climate Change Adaptation and Mitigation

Under the UNFCCC, every country is required to develop a climate response programme that integrates climate change activities into all relevant sectors including energy, transport, industry, agriculture, forestry and waste management. Climate change has devastating effects on the lives of people, so any action taken to reduce its potential effects should seriously consider social, economic and political problems.

In keeping with the above terms of reference, the Government of Kenya has established a National Institutional Body with branches all over the country including Trans Nzoia district to spearhead climate change adaptation and mitigation programmes.

4.5.1 National Climate Change Activities Coordinating Committee (NCCACC)

Its members are drawn from ministries of agriculture and forestry, energy, planning, finance, industry, research and technology, municipal councils, public universities, the private sector and from non-governmental organizations. The NCCACC aims to help local communities with climate change *adaptation* and *mitigation* through the following measures;

- creating public information and awareness on climate change to the local population in Trans Nzoia;
- working with the farmers in Trans Nzoia to adopt the planting of drought resistant varieties of crops to guard against crop failure;
- promoting the planting of genetically improved cross-variety seeds that mature fast and offer better harvest in terms of yield volumes;
- sensitizing the local population on the importance of natural resource preservation such as forests to improve micro-climate;
- helping farmers through providing free tree seedlings and subsequent extension services to enable them benefit from the carbon trading schemes;
- investing heavily in water harvesting activities in the semi-arid areas by drilling boreholes and constructing dams and water pans;

The above government organization has already initiated intense programmes aimed at achieving the above objectives and it has fully involved community members who appreciate its role as evidenced by Samuel Sitta, a commercial maize farmer in Kitale who said;

"I have been receiving both financial aid and material support from the mentioned government agency in order to boost yield production in face of unfavorable climate change effects that have led to difficult conditions in terms of agricultural productivity. The free fertilizers and improved seed varieties have made me overcome these challenges"

Similar sentiments were echoed by almost all respondents in areas where the above government agency had operations. Willy Mutheu, a pastoralist said;

"The government body has really helped our communities in the semi-arid areas by drilling water points that enable us to water our animals even during the worst dry seasons thereby being able to maintain our cattle in good health compared to before when we would loose many herds to drought"

4.5.2 Climate Network Africa (CNA)

The above mentioned International Organization is mostly concerned with research and mapping of climate data models for different high impact areas such as Trans Nzoia which is privileged to have a regional office due to its high agricultural potential and role in food security as far climate change mitigation and adaptation is concerned. Programmes reports drawn by the above organization are transmitted to the government for onward implementation. The above mode of operation has led to majority of residents not relating directly with the organization since it does not directly deal with them but operates through government proxy.

4.5.3 African Centre for Technology Studies (ACTS)

The above International Organization is also working from a regional level in Trans Nzoia district and its role in ensuring climate change is tackled efficiently is vested mostly in training and policy formulation through a number of responsibilities entrusted to them. Some of the activities carried out by the organization include;

- ensure the establishment of a properly networked database on climate change, impact and response strategies, and research activities;
- identify and facilitate development of national research programmes on climate change, impacts and responses strategies and options, and advise the government on studies for which funding by the Global Environment Facility (GEF) or any other international financial mechanisms is required;
- identify research projects requiring regional and international cooperation;
- identify scientists who could be called upon to undertake specific research in climate change, impacts and response strategies;

It has published reports on challenges faced by the vulnerable communities in Trans Nzoia thereby enabling government to exploit funding opportunities from the Global Environment Facility (GEF) grant that has further boosted adaptation and mitigation measures.

4.5.4 Swedish Environment Institute (SEI)

The above International Organization is also very active in the study area and is mostly funding environmental protection activities geared towards rehabilitation and mitigation.

It has successfully lobbied the local community into using indigenous knowledge and practices that are conducive for environmental conservation while discouraging those likely to lead to the increase in severity of the climate change effects. The local community also identifies with them greatly due to their efforts in enabling farmers grow trees and therefore benefit from the carbon trading initiative. James Wekesa has this to say;

"The organization helped me turn my fortunes around by supporting my efforts to plant fast growing tree varieties on my large piece of idle land and they also registered me in the list of farmers directly benefitting fro GEF grants meant to promote conservation practices among local communities. I am very grateful to them"

Also, through lobbying the communities in the study area to dedicate at least 10% of their farms to tree growing and offering free seedlings, extension services through peace crops and subsequent registration of farmers to benefit from GEF carbon grants, the above organization was established to have had a very positive interaction and effect in helping communities in mitigating and adapting to climate change.

4.5.5 United Nations Environment Programme (UNEP)

This is the largest International Body tasked with Climate Change adaptation and mitigation measures worldwide and has it's headquarters in Nairobi, Kenya with subsequent regional offices spread all over including a very central one in Trans Nzoia District. It has promoted adaptation and mitigation among communities through the activities below;

4.5.5.1 Mitigation Measures

- increasing awareness levels through public forums and workshops;
- promoting energy efficiency measures through conservation efforts;
- promoting low carbon energy supply through investing in renewable energy;
- change of agriculture and forestry practices that abate climate change;
- changes in production and consumption behavior to promote sustainable development;

4.5.5.2 Adaptation Measures

- promoting improvement of the general resilience of social and material infrastructure;
- improving water resource management within the local communities
- investing in agriculture, forestry and fisheries;
- estimating and preparing for future disease outbreaks
- encouraging management of existing environmental threats like *deforestation*;

The research further established that despite possessing unmatched resources in terms of both human and financial capital, the adaptation and mitigation measures promoted by the above organization have continued to face challenges due to their highly technical and scientific methods that require radical shifts in the communities' ways of life and social thinking that they hold dear.

Respondent Aggrey Apollo of Cherangany evidenced the above when probed about the effectiveness of measures introduced by the international body;

"These people want us to stop cutting trees for firewood from the forest and instead use biogas that they promise to help us build through technology and also they want us to keep less cattle and sell the rest and we cannot agree since that is not in line with our heritage or culture"

The above were the government and international organizations involved in conducting adaptation and mitigation measures in the larger Trans Nzoia District as ascertained by the research carried out in the above study area. They are very powerful and resourceful as well as qualified to combat the effects of climate change and help local communities in the process.

CHAPTER FIVE
CONCLUSIONS AND RECOMMENDATIONS

5.2 Conclusions

Similar to research carried before by Gallup concerning global knowledge and awareness on climate change, the research found out that indeed awareness, which is the foundation to understanding climate change tends to be lowest in regions where populations are more vulnerable to the effects of the global phenomenon. Communities residing in the Trans Nzoia showed a general lack of knowledge and understanding as to the complex nature of climate change and its resultant effects.

The above is mainly due to the low levels of education prevalent among many adults in the study area who due to prior abundance of very vast tracts or high arable land coupled with favorable climate regimes, did not pursue formal education past primary level and instead opted to go into farming that was very profitable then due to government assistance. The climate change apathy in the area therefore corresponds to Gallup's findings that educational attainment is the single most important factor in raising awareness on climate change.

Communities in Trans Nzoia are very much aware that the weather patterns have changed and they have their own indigenous knowledge that explains the above occurrences in deep detail that at times has some basic familiarities with the climate change phenomenon, but due to their detachment of the above subject matter to its scientific basis, their awareness levels as shaped by indigenous knowledge has continued to make them ignorant and place them at very high risks to climate change effects.

As the saying goes *"He who feels it, knows the pain"*, the research found out that the communities in Trans Nzoia have indeed suffered the effects of climate change as shown in the findings of the study and are therefore more than willing to accept the fact that urgent action needs to be taken in order to reverse or alleviate their suffering that is directly linked to changing temperatures and precipitation patterns that affect both their livelihoods and socio-economic status.

The study further revealed a general lack of correlation between effects on climate change such as spread of tropical diseases to the phenomenon itself. Such levels of ignorance render ineffective, the efforts put in place such as the *National Malaria Prevention Programme* by the

Government since the communities are contented and regard the disease as a way of life rather than a calamity caused by global warming.

Finally, the study found out the existence of numerous Government of Kenya, Local NGOs and International Organizations Programmes concerned with climate change mitigation and adaptation in Trans Nzoia District. Despite all these efforts though, there is still a lack of research, general awareness about climate change issues, the existence of the UNFCCC, and about the opportunities it provides for mitigation and adaptation to climate change among the communities in the study area.

5.3 Recommendations

The fact that Kenya as a country has been well represented in most climate change debates at scientific, intergovernmental and non-governmental fora, coupled with efforts that have resulted into the publication of several climate change articles being done i n the country, including those by CNA (Impact Quarterly), ACTS/SEI, the Kenya Academy of Sciences, and individuals, yet the awareness levels on climate change still remain low as evidenced by the study carried out in Trans Nzoia, I would recommend the following steps to reverse the awareness trends and improve climate change mitigation and adaptation;

5.3.1 Environmental Education on Climate Change

The research findings established that climate change awareness is directly correlated to the level of education attainment, a fact that is consistent with findings of a similar research carried out by Gallup on a much wider context that measured awareness levels throughout the globe. I therefore would recommend that the relevant line ministries involved in matters regarding climate issue to come up with a curriculum on climate change through collaboration with the ministry of education that should be implemented right from primary school level.

By so doing, the basic principles of climate change and its relevant concepts on what variables are responsible for causing it coupled with the scientific evidences that support its occurrence on a global scale will have been inculcated into the local populations at a very tender age and will ensure awareness levels increase sharply since the government has already put in place free primary and secondary education that makes it a criminal offence for all school age going

citizens not to enroll. The above program through relevant government enforcement mechanisms will ensure a generation that is very conscious and aware of climate change issues.

5.3.2 Public Awareness and Sensitization on Climate Change Effects

Since the above recommended programme will need some time to produce a new generation of climate change aware citizens, other shorter term initiatives to sensitize the communities on the effects of climate on both their livelihoods and its socio-economic implications is required as a matter of urgency. The study revealed that it is generally assumed that by suffering the effects of climate change, communities are aware of their predicaments but that is not the true picture as majority of respondents interviewed draw no correlation between their situations as direct results of scientific climate change.

5.3.3 Establishing Indigenous Knowledge Reservoir Centre's

As long as communities continue to misinterpret climate change due to outdated indigenous knowledge as was the case during the research undertaking, no viable programmes aimed at helping them to cope with the effects are likely to be successful since there is likely to be cross-purpose objectives that are likely to clash unless reconciled and the positive encouraged and harnessed to correspond to the more established scientific facts on climate change effects while the negative should be discarded. The establishment of indigenous knowledge centre's in specific central areas to act as points of information dissemination is likely to have very positive results.

5.3.4 Promoting Local Needs Oriented Mitigation and Adaptation Measures

The research found out that despite the fact that Kenya and by extension Trans Nzoia district is privileged to have powerful local and International Organization programmes on Climate Change Mitigation and Adaptation operating from the region, the effects nonetheless continue to ravage the local communities depriving them of opportunities to better their lives through both financial and technical mitigation and adaptation measures available.

The above can be corrected by carrying out needs assessment into the possibility of fusing indigenous knowledge and practices that are positive and can gain wide acceptance among community members in terms of adaptation and mitigation other than the current transfer of

technology and highly scientific oriented measures that are impractical in such areas as Trans Nzoia due to the low advent and challenges in the science and technology sector.

5.5.5 Changing Approaches on Combating Climate Change

As established by the research undertaking, it is imperative to understand that global climate change is fundamentally different from the conventional environmental agenda where the practice has been to react and correct. The challenge now is to anticipate and prevent any scientifically predicted future discourse that climate change is likely to result into. By so doing, the relevant authorities are likely to cushion these vulnerable communities such as the ones in Trans Nzoia from suffering the worst possible effects of climate change thereby improving their overall welfare and future opportunities.

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APPENDICES

Appendix (i) Work Schedule

It is expected that this research will be concluded in six months depending on the availability of the requisite tools and materials required to successfully undertake it.

S/No	Activity	Duration
1	Gathering of secondary information and proposal writing	December 2009 to January 2010
2	Presentation of the research proposal to the supervisor	January to February 2010
3	Preparations and organizing materials for survey. This will include:- ▪ Questionnaire design ▪ Transport hiring ▪ Household interviews □ Observation from the field □ Literature reviewing in libraries, internets, visiting organizations to collect information on effects of climate change on communities.	March 2010
4	Data analysis	April 2010
5	Report writing	May 2010
6	Presentation and submission of the research report	June 2010

Appendix (ii) Budget

S/N	Particulars	Cost (Kshs)	Total Cost (Kshs)
1	▪ Researcher's meal allowances ▪ Meal allowances for Research assistants ▪ Soft drinks and bites for interviewees	1000/= @ 30 days 2 people X 6 days @ 500/= 100 people X 200/=	30,000/= 30,000/= 20,000/=
2	Materials □ Stationery □ Maps □ Photocopy and secretarial service	Its total cost will be 20,000/=	20,000/=
3	Logistics □ Transport and communication □ contingency	Its total cost will be 50,000/=	50,000/=
Total budget			**150,000/=**

Appendix (iii) Research Questionnaire

Dear respondent, my names are Victor Otieno Mgelle of Kampala International University, Uganda. I humbly request your indulgence in answering these questions below which will provide useful information for the purposes of this research study.

Topic:

Communities' Awareness on Climate Change and its Effects: A Case Study of Trans Nzoia District, Kenya.

Section A: Personal Information

RESPONDENTS NAME: ..... **SEX:** .....

VILLAGE: ..... **WARD:** .....

DIVISION: ..... **DISTRICT:** .....

REGION: ..... **DATE:** .....

Section B: Household Characteristics

1. Head of the household: (a) Male (b) Female.
2. Age of the head of the household ..... (Years).
3. Form of Education: (a) None (b) Primary (c) Secondary (d) Post Secondary (e) Adult Education (f) Others (Specify) .....
4. What is the total number of persons leaving in your household (including relatives)

Adult male (15 yrs and above) ..... Adult female .....

Youth and children under 15 years .....

5. How long has the family resided in the study area? .....
6. Does the family historically hail from the study area or did they migrate from other locations into the area? .....

Section C: Awareness on Climate Change and its Causes

7. What do you understand by the term "Climate Change"? .....
8. How much do you know about global warming or climate change? .....
9. How serious of a threat is climate change or global warming to you and your family? (a) Very Serious (b) Somewhat Serious (c) Not very serious (d) Not at all serious
10. Based on your answer above, why do you consider it so? .....
11. How has the climatic patterns changed over the last 20 years? .....
12. What do you think are the likely causes of the experienced changes in weather patterns and climate trends? .....
13. In your opinion, do you believe these changes in weather patterns are as a result of global warming or climate change? (a) Yes (b) No
14. If your answer above is yes, why do you say so? .....
15. If your answer above is No, what do you rather attribute these changing weather occurrences to? .....
16. What indigenous beliefs does your culture attribute to climate change? .....
17. Can you point out some physical evidence to support the occurrence of climate change in your home area? .....
18. How do you justify the above as being related to climate change? .....

Section D: Effects of Climate Change on Communities

19. What are some of the effects of climate change known to you? .....
20. In your own opinion, how do you view or regard these effects that result from climate change? (a) Positively (b) negatively

21. What major economic activity is your family dependent on? .....

22. To what extent does the economic activity mentioned above depend on the natural weather or climate pattern (a) Fully dependent (b) Moderately dependent (c) Slightly dependent (d) Non dependent

23. If your answer to question 20 above is (a), how has the change in weather patterns and climatic seasons affected your social welfare? .....

24. If answer is (b) in question 20 above, how have the said changes likewise affected the quality of your living standards? .....

25. What major physical features have been affected by the said change? (a) Water Sources (b) Natural Vegetation (c) Livestock (d) Soil Fertility

26. Why do you say so in question 26 above? .....

27. Are you aware of the related effects of Climate Change on Tropical Diseases? (a) Yes (b) No

28. How is climate change related to increased malarial prevalence? .....

29. Have you and your family had to migrate to other areas due to changing climatic conditions? .....

30. How has climate change affected the rate of development in your area of residence? .....

.....End.....

Thanks for Your Cooperation

Appendix (iv) Interview Guide

1. Are you aware of the ongoing global debates concerning "Scientific Climate Change" and its effects? .....
2. What community based organizations are currently operational in the study area to help with the experienced changes? .....
3. What government and international organization programmes on climate change mitigation and adaptation are being undertaken in this district? .....
4. In your opinion, do you believe the communities you work with are aware of climate change and its effects? .....
5. Do you think the level of science and technology in the region is adequate in combating the effects of climate change? .....
6. Do you believe there is dissemination of adequate information on the issue of global warming and climate change? .....
7. Do you believe your interaction with the communities in the study area has resulted in raising their awareness levels on the climate change issue? .....
8. What are some of the home grown solutions that communities can utilize to adapt to climate change? .....
9. To what extent do you realize that most causes of climate change originate in the developed world? .....
10. What do you understand by the term "Climate change adaptation and mitigation measures".....
11. Are you aware of global efforts geared by the UNFCCC and IPCC in reversing or combating the causes of global climate change? .....

12. Do you believe that the current trends in weather and climate variability constitute a global crisis? .....

13. Do you believe the issue of climate change has been given the necessary attention required to tackle it? .....

14. Has the developed world been sincere in their quest to help governments of poor nations deal with effects of climate change? .....

15. Are you aware that as a country, Kenya is a negligible emitter of GHG gases and contributor to climate change but suffers the worst effects? .....

16. Do you believe that the Kyoto protocol was adhered to by the developed nations? .....

17. What is your opinion on what the ideal situation ought to be as regards sharing responsibilities to tackle climate change between rich and poor countries? .....

18. What are the prospects of both developed and developing nations reaching consensus on a post Kyoto climate deal? .....

19. What is your take on Government intervention measures, if any, that have been put in place to shield communities from climate change effects? .....

20. What personal message plea would you want me as a researcher to relay on your behalf to the world concerning your plight? .....

Thank You

Appendix (v) Checklist for Researchers.

RESEARCHER'S NAME: ..... SEX: .....

DEPARTMENT: ..... DATE: .....

1. Did you do research on Climate Change Effects in Trans Nzoia District...YES or No. If YES, in which administrative division?

a. Central
b. Cherangany
c. Endebess
d. Kwanza
e. Saboti

2. When did you start documenting changes in rainfall regimes and weather patterns in Trans Nzoia?

(a) 20 years ago, (b) 10 years ago, (c) 5 years ago, (d) Never before.

- Highlight reasons observed and deduced for the occurrence of climate change?

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.....

3. What observable effects did the communities seem to suffer from most as a result of climate change?

(a) Droughts (b) Floods (c) Declining Crop Production (d) Tropical Diseases

To what extent were the communities aware that climate change was the cause of the above predicaments?

.....

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4. What physical evidence of climate change did you notice on the area under investigation?

(a) Extreme Weather Events (b) Extinction of Species (c) Melting Ice Caps (d) Migration

- To what extent did the identified physical evidence of climate change recorded in the study area raise people's awareness on the phenomenon?

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5. What Governmental Departments or International Organizations concerned with climate change were present in the area?

(a) UNEP (b) Meteorological Department (c) NEMA (d) Forestry Department

- To what extent were the programmes introduced by the above agencies help local communities deal with climate change effects?

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6. What do you believe is the way forward in helping these vulnerable communities adapt and mitigate climate change effects?

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THANKS FOR YOUR COOPERATION