ASSESSING WOMEN DOMESTIC CHORES AND VULNERABILITY TO CLIMATE VARIABILITY IN CHEPSEON SUB LOCATION, NAKURU COUNTY, KENYA

BY

KOSKEI NANCY CHEBET (B.Ed.Sc.)

N50/21897/2010

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Environmental Studies (Climate Change and Sustainability) in the School of Environmental Studies of Kenyatta University

NOVEMBER, 2013

DECLARATION

Declaration by Candidate:

This thesis is my original work and has not been presented for a degree in any other university or any award.

Koskei Nancy Chebet

Department of Environmental Education

Signature: **……**Date: **……**

Approval by Supervisors:

We confirm that the work reported in this thesis was carried out by the candidate under our supervision.

Dr. Richard K.A. Kerich

Department of Environmental Education

Kenyatta University

Signature: **……**Date: **……**

Dr. James K.A. Koske

Department of Environmental Education

Kenyatta University

Signature: **……**Date: **…….**

DEDICATION

This work is dedicated to my parents Mr. Joel Koskei and Mrs. Angeline Koskei for their sacrifice and commitment towards my education, and to my beloved family Erick and daughter Shirlynn.

ACKNOWLEDGEMENT

This work has been completed through the assistance and cooperation of several people. First, gratitude goes to my supervisors Dr. Richard K.A Kerich and Dr. James K.A Koske for their academic, moral support and guidance throughout my study. Secondly, I acknowledge the following persons for advice in the course of my study: Mumin Ndenge Ndzoga, Geoffrey Lenyayon Lelenguyah, Irene Okeyo, Lucy Kiarie and Joseph Maina Macharia. Special thanks go to the staff of Environmental Studies for laying my foundation in my study area. I cannot forget to thank my family for their support and patience during this study. Finally I appreciate the support and responses given by women in Chepseon Sub location, Nakuru District Environmental Officer, Nakuru District Agricultural officer and representatives from Social and Economic Women Organizations in Chepseon Sub location without whom this work would not have been accomplished.

TABLE OF CONTENTS

DECLARATION ii
DEDICATION iii
ACKNOWLEDGEMENT iv
TABLE OF CONTENTS v
LIST OF FIGURES vii
LIST OF TABLES x
LIST OF PLATES xi
LIST OF ABBREVIATIONS AND ACRONYMS xii
ABSTRACT xiii
CHAPTER ONE: INTRODUCTION 1
1.1Background 1
1.2 Statement of the Problem 2
1.3 Justification 3
1.4 Objectives of the Study 3
1.5 Research Questions 4
1.6 Hypotheses 4
1.7 Conceptual Framework 4
1.8 Definitions of Terms 6
CHAPTER TWO: LITERATURE REVIEW 8
2.1 Introduction 8
2.2 Anthropogenic Causes of Climate Change 8
2.3 Effects of Climate Change 9
2.4 Climate Change in Africa 10
2.4.1Consequences of Climate Change in Africa 10
2.5 Climate Change in Kenya 14
2.5.1 Impacts of Climate Change in Kenya 17
2.6 Climate Change and the Millennium Development Goals (MDGs) 18
2.7 Millennium Development Goals in Kenya 18
2.8 Women's Vulnerability to Climate Variability 20

2.9 Climate Variability Awareness 21
2.10 Related Studies on Women's Vulnerability to Climate Variability 21
CHAPTER THREE: METHODOLOGY 23
3.1 Study Area 23
3.2 Research Design 23
3.3 Population of the Study 24
3.4 Sampling Procedure 24
3.5 Sample Size 25
3.6 Instrumentation 26
3.7 Data Collection Procedures 26
3.7.1 Pilot Study 26
3.7.2 Data Collection 26
3.8 Data Analysis 27
CHAPTER FOUR: RESULTS AND DISCUSSION 28
4.1 Introduction 28
4.2 Characteristics of Respondents 28
4.2.1Women's Age and Family Size 28
4.2.2 Education, Sources of Income and Professional Training 30
4.2.3 Size and Type of farmland 32
4.2.4 Women's Domestic Chores 33
4.3 Determining Climate Variability in Chepseon Sub-location 34
4.3.1 Precipitation Analysis in Chepseon Sub-location from 1982-2011 34
4.3.2 Analysis of Average Temperature Trends in Chepseon Sub Location (1982-2011) 40
4.3.3 Variability of Annual Mean Minimum Temperature for 30 year period for Chepseon Sub location 44
4.4 Relationship between Climate Variability Awareness and the Level of Education 47
4.5 Variability in Climatic Conditions 48
4.6 Changes in the Planting Season 49
4.7 Source of Climate Change Information 51
4.8 Irrigation of Crops 52

4.9 Access to Credit Facilities by Women in Chepseon Sub location 54
4.10 Sources of Water 56
4.11 Main Source of Energy for Cooking 58
4.11.1 Source of Fuel Wood for Cooking 58
4.12 Challenges Faced in Accessing Medical Facilities 61
4.13 Access to Subsidized Farm Inputs 64
4.14 Road Conditions in Chepseon Sub location 64
4.15 Access to Downscaled Weather Information in Chepseon Sub location 66
CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS.....68
5.1 SUMMARY 68
5.2 CONCLUSION 68
5.2.1 Climate variability has been experienced in Chepseon sub location from 1982-2011 68
5.2.2 There was no significant relationship between women's level of education and climate variability awareness in Chepseon sub location 69
5.2.3 Women domestic chores and adaptive strategies that they had in place to cushion them from harmful effects of climate variability 69
5.3 RECCOMENDATIONS 71
5.3.1 Recommendations on adaptation and coping strategies to be employed by women in adjusting to climate variability in Chepseon sub location 71
5.3.2 Recommendations for improving women's resilience to climate variability in Chepseon sub location 71
5.3.3 Recommendation for further research 72
REFERENCES 73
APPENDICES 79
Appendix I. Establishing the linkages between MDGs, climate change and gender.... 79
Appendix II: Women's domestic chores and their vulnerability to climate variability questionnaire 81
Appendix III: Access to savings and credit facilities by women in Chepseon sub-location questionnaire 88
Appendix IV: Questionnaire for Nakuru District Environmental Officer 90
Appendix V: Access to Agricultural Inputs by Subsistence Female Farmers. 92

LIST OF FIGURES

Figure 1.1: Women's domestic chores vulnerability to climate variability. 6
Figure 3.1: Study Area Map 23
Figure 4.1: Women's income levels per month in Chepseon sub-location 32
Figure 4.2: Type of farmland per village in Chepseon sub-location 33
Figure 4.3: Women domestic chores in Chepseon sub location. 34
Figure 4.4: Precipitation flow using 5-year moving averages (1982-2011): Chepseon, Nakuru County. Source: KMD, Nakuru Station no: 9036261. 35
Figure 4.5: Deviations of precipitation from 30 year mean (1982-2011): Nakuru County. Source: KMD, Nakuru Station no: 9036261 37
Figure 4.6: Total monthly precipitations (1982-2010): Nakuru County. Source: KMD, Nakuru Station no: 9036261. 38
Figure 4.7: Deviations from mean monthly precipitation (mm) (1982-2011): Nakuru County. Source: KMD, Nakuru Station no: 9036261. 39
Figure 4.8: Average temperature trends for Chepseon sub location (1982-2011): Nakuru County. Source: KMD, Nakuru Station no: 9036261. 40
Figure 4.9: Variability of Annual Mean Maximum Temperature from the 30 Year Mean from 1982-2011: Nakuru County. Source: KMD, Nakuru Station no: 9036261 41
Figure 4.10: Mean Monthly Maximum Temperature (˚C) from 1982-2011: Nakuru County. Source: KMD, Nakuru Station no: 9036261. 42
Figure 4.11: Mean Monthly Maximum temperature extremes from 1982-2011: Nakuru County. Source: KMD, Nakuru Station no: 9036261. 43
Figure 4.12: Variability of Annual Mean Minimum Temperature from the 30 Year Mean from 1982-2011: Nakuru County. Source: KMD, Nakuru Station no: 9036261 44
Figure 4.13 Mean monthly minimum temperatures (1982-2011): Nakuru County. Source: KMD: Nakuru Station no: 9036261. 45
Figure 4.14: Minimum temperature extremes (1982-2011): Nakuru County, KMD: Nakuru Station no: 9036261. 46
Figure 4.15: Level of education in Chepseon sub-location 47
Figure 4.16: Climate variability awareness in Chepseon sub-location 48
Figure 4.17: Time period in which climate variability have been observed in Chepseon sub-location 49
Figure 4.18: Changes in the planting season in Chepseon sub-location. 50
Figure 4.19: Length of time they have noticed changes in climatic conditions in Chepseon sub-location. 51
Figure 4.20: Crops irrigated in Chepseon sub-location. 53
Figure 4.21: Main Source of Water in Chepseon sub-location. 57
Figure 4.22: Source of energy for cooking in Chepseon sub location 58
Figure 4.23: Source of fuel wood for cooking in Chepseon sub location. 59

Figure 4.24: Challenges faced in accessing medical facilities in Chepseon sub-location. 62
Figure 4.25: Challenges faced by women in accessing medical facilities in Chepseon sub location..... 63
Figure 4.26: Access to subsidized farm inputs in Chepseon sub-location..... 64
Figure 4.27: Level of satisfaction with road conditions by women in Chepseon Sub location..... 65
Figure 4.28: Level of satisfaction with the road conditions in Chepseon sub-location.... 66

LIST OF TABLES

Table 2.1:Number of people in Kenya requiring relief in the worst flood and drought disasters since 1971.....15

Table 2.2 Areas and number of people affected by floods in Kenya (1997-2009).....16

Table 2.3:Minimum temperature trend from 1960-2010 in Kenya 17

Table 2.4:Maximum temperature trend from 1960-2010 in Kenya.....17

Table 3.1:Number of households included in the sample.....25

Table 4.1:Mean age and standard deviation for women in Chepseon sub location..... 28

Table 4.2:Women's age bracket in Chepseon sub location 29

Table 4.3:Women's level of education in Chepseon sub location..... 30

Table 4.4:Women's source of income in Chepseon sub location..... 31

Table 4.5:Five- year moving averages for total annual rainfall (mm):1982-2011.Nakuru County..... 36

Table 4.6: Sources of climate change information in Chepseon sub location 52

Table 4.7: Access to credit facilities by women in Chepseon sub location..... 55

LIST OF PLATES

Plate 4.1 Woman irrigating her tomatoes in Chepseon sub-location…….54

Plate 4.2 Fuel wood stored for heating and cooking……. 60

Plate 4.3 Biogas plant in a rural home in Chepseon sub-location…….61

LIST OF ABBREVIATIONS AND ACRONYMS

CCC	Convention on Climate Change
COP	Conference of Parties
DAW	United Nations Division for the Advancement of Women
FAO	Food and Agriculture Organization
GOK	Government of Kenya
GDP	Gross Domestic Product
GHGs	Greenhouse Gases
IPCC	Intergovernmental Panel on Climate Change
KMD	Kenya Meteorological Department
MDGs	Millennium Development Goals
PPM	Parts Per Million
RRWS	Rongai Rural Water Supply
UNDP	United Nations Development Program
UNESCO	United Nations Education, Scientific and Cultural Organization
UNIFEM	United Nations Development Fund for Women
UNFCCC	United Nations Framework Convention on Climate Change

ABSTRACT

Climate change is a major challenge of mankind in the 21st century. While climate change existed even in the pre-industrial era, recent trends exacerbated by human activities have raised global concern that climate change is threatening the achievement of sustainable development. While effects of climate change have been experienced all over the world, developing countries will be hardest hit because this is where millions of the world's poorest people are already being forced to cope with its impacts, yet they contributed less to historic GHG emissions. Kenya is vulnerable to climate change because most of her people's economic activities are dependent on climate sensitive natural resources. This study was done to assess women domestic chores and vulnerability to climate variability in Chepseon sub location, Nakuru County, Kenya. The objectives of the study were to determine climate variability from 1982-2011, to find out if there was a relationship between climate variability awareness and women's level of education and to investigate adaptive strategies that women had in place to cushion them from climate variability in Chepseon Sub location, Nakuru County of Kenya. Descriptive survey was used to solicit data on women's domestic chores and their vulnerability to climate variability. A sample size of 90 households was selected through stratified random sampling. Questionnaires were used to collect data. Climate variability data spanning 1982 to 2011 were obtained from Kenya Meteorological Department. Results were discussed and presented as descriptive statistics in tables and graphs. Annual precipitation trend showed a general increase from 1071.5mm in the year 1982 to 1106.5mm in the year 2011. Five year moving averages also showed variability in the amounts of rainfall received, with the first five years rising from 900.54mm to 918.60mm in the next five years then decreasing to 797.96mm in the next five years that followed. Average rainfall then rose to 913.24mm in the next five year. The years 2002-2011 indicated a relative increase in the average annual precipitation from 1018.98mm to 1087.24mm. This trend showed variability of rainfall over the years which were also unpredictable. Temperature analysis also showed variability in both minimum and maximum temperatures. The mean monthly minimum temperature depicted a positive trend from 10.39˚C in the month of January to 10.64˚C in the month of December while the mean monthly maximum temperature depicted a negative trend from 27.3˚C in the month of January to 25.73˚C in the month of December over the 30 year period. Chi-square test results indicated that there was no significant relationship between the level of education and climate variability awareness among the respondents in Chepseon sub location (χ^2 =2.595, df= 4, 89 and p=0.458). Majority (49%) of those that were aware of climate variability had only completed primary school level. The possible explanation for this was that they could not gain access to formal employment and could only carry out domestic chores which involved using natural resources that were at risk of climate variability. Climate variability was experienced in Chepseon sub location and women were not well adapted to changes in climatic conditions. Awareness on the causes and consequences of climate variability should be made in order to sensitize women on its' challenges and the possible ways of adapting to it.

CHAPTER ONE: INTRODUCTION

1.1Background

Over the recent decades climate change and global warming have become issues of global concern. The world's temperatures are slowly rising, rainfall patterns have changed over the years, and the same applies to wind patterns and ocean currents (IPCC, 2007). As a result, the earth is experiencing melting of glaciers, expansion of oceans, floods, droughts, destructive hurricanes, heat waves, changes in growing seasons which are becoming a major challenge to mankind (UNDP, 2007). According to estimates by IPCC (2007), global temperatures are expected to rise by 2- 3 ^{o} C by the year 2100. Similarly, sea level is expected to rise by 10-90 cm by the year 2100 (IPCC, 2007). These calls for immediate action to mitigate climate change in order to avoid related catastrophes that threaten to erode human freedoms and limit choice.

According to UNDP (2009), climate change has been experienced all over the world and has had serious threats on sustainable human development. It further states that, even if Green House Gas (GHG) emissions are cut to zero at the moment, the world would still experience the effect of global warming from the heritage of past emissions. The harmful effects of climate change will be experienced much by developing countries, where millions of the world's poorest people are already being forced to cope with its impacts, yet they contributed less to historic GHG emissions (UNDP, 2010).

Although Africa contributes negligibly to total GHG emission (only 4%) compared to worlds largest emitters like China which contributes 23.5%, United States of America (USA) which contributes 18.27% and European Union (EU) which contributes 13.98%, it is hardest hit making it hard to alleviate poverty (UNECA, 2010).The poor suffer the brunt of climate change in present world because of their dependence on climate sensitive resources and their lack of financial capacity to adapt to climate change while in future it will be humanity as a whole that will face the risk that comes with global warming (UNDP, 2007). Africa is mostly affected by climate change because of poverty, its geographical location and its dependence on climate-sensitive resources. Africa is characterized by rain-fed agriculture which comprises 23% of Gross Domestic Product

(GDP) and employs 70% of the population, except South Africa (World Bank, 2010). Most of the people who live in rural Africa comprises the poor whose main economic activity is subsistence farming which relies on rain-fed agriculture. Africa lacks property and financial measures to adapt to climate changes (FAO, 2010).

Boserup (1989) describes Africa as a region of female farming and states that nearly all African communities have left the task of food production to women. They come in contact with natural resources on daily basis and are therefore referred to as managers of natural resources that are at risk of climate change. They are responsible for subsistence farming, fuel wood collection, fetching water, fodder provision for livestock and provision of nutritional requirements for their families (UNDP, 2009).In Kenya, climate change has already been experienced which has led to more frequent floods and droughts (ROK, 2010 a). Women have been identified to be among the most vulnerable groups to climate variability because of their dependence on climate sensitive natural resources in accomplishing their domestic chores.

1.2 Statement of the Problem

According to UNDP (2009), climate change has had an effect on natural resources such as water, forests and biodiversity. Changes in precipitation, melting ice patterns and reduction in the amounts of glacier will affect the levels of rivers and lakes, limiting access to drinking water. Rise in temperature will lead to increased evapo-transpiration, reduced runoff and infiltration which results in decreased availability of fresh water used for domestic purposes. Overexploitation of forests is likely to occur as a result of increased poverty, population increase and climate change. As population increases, there will be more demand for fuel wood (Sands, 2005). This is because forests provide vital source of fuel wood in developing countries and the poorest are those who utilize fuel wood the most. Different species of trees respond differently to climatic factors and they are expected to have a negative impact on the agricultural sector (Kowero, 2011).According to Thullier (2007), biodiversity ecologists' state that 15-37% of natural species may be extinct by 2050 as a result of habitat change and climate change. Women living in rural African communities have been assigned roles that largely depend on natural resources. They are responsible for fuel wood collection, water provision for

domestic use, provision of nutritional requirements of their families and taking care of the old and young members of their families (UNDP, 2009). The natural resources on which they depend upon to accomplish their domestic tasks are climate sensitive thereby making them particularly vulnerable to climate variability. According to ROK (2010b), women in Kenya are vulnerable to damages caused by climate variability and therefore their vulnerability to climate variability needs to be determined. The purpose of this study was to assess women domestic chores and vulnerability to climate variability in Chepseon sub location. From the available literature, little information on the impact of climate variability on women's domestic chores in Sub Saharan Africa is available. There is no similar research that has been done in Chepseon sub location.

1.3 Justification

Findings from the study will be useful in determining women domestic chores and vulnerability to climate variability in Chepseon sub location. These will be useful in recommending suitable adaptation and coping strategies that will address women's vulnerability and to build their resilience to climate variability. Similarly, the study is expected to be useful to the government especially Ministry of Gender and Sports in ensuring that programs that are meant to empower women are put into consideration in order to reduce women's vulnerability to climate variability. The study will also be useful to other researchers concerned with issues of gender empowerment.

1.4 Objectives of the Study

The main objective of the study was to assess women's domestic chores and vulnerability to climate variability in Chepseon Sub Location. This was addressed by the following specific objectives.

1. To determine climate variability in Chepseon Sub Location from 1982-2011.
2. To find out the relationship between women's level of education and climate variability awareness in Chepseon Sub Location.
3. To identify women domestic chores and adaptive strategies they have in place to cushion them from climate variability.

1.5 Research Questions

The study sought to answer the following questions;

1. Has climate variability been experienced in Chepseon Sub Location from 1982-2011?
2. Does women's level of education influence their climate variability awareness?
3. What domestic chores do women carry out and adaptive strategies do they have in place to cushion them from climate variability?

1.6 Hypotheses

Based on the objectives of the study, the following hypotheses were tested in the study:

1. Climate variability has not been experienced in Chepseon Sub-Location from 1982-2011.
2. There is no significant relationship between women's level of education and climate variability awareness in Chepseon sub location.
3. Women in Chepseon Sub location do not have adaptive strategies to cushion them from climate variability.

1.7 Conceptual Framework

Climate change has had an impact on natural resources. Women in Sub-Saharan Africa have been ascribed roles that largely depend on natural resources making them particularly vulnerable to climate variability. According to IPCC (2001), vulnerability of women domestic chores to climate variability is considered as a function of exposure, sensitivity and adaptive capacity. It is a combination of how women domestic chores are exposed, sensitive and their capacity to adapt to climate variability. The most important factors shaping women's adaptive capacity are: availability of infrastructure, access to technology, level of education, access to credit facilities and irrigational facilities. Infrastructure enables women to gain access to market their farm produce and to get farm inputs in a timely manner, access to technology e.g. radios and internet enables them to gain access to climate variability information thereby are in a better position to adapt to

climate variability. Level of education is also important in determining how an individual can interpret climate variability information they come across. Irrigational facilities will enable women to adapt to climate variability during dry seasons.

Deressa *et al.* (2008) states that the most important factors shaping women domestic chores exposure to climate variability are: availability of institutions to inform them of changing climatic patterns, access to water and varying climatic conditions. Women domestic chores sensitivity to climate variability is determined by access to technology e.g. radios and internet to enable them gain access to climate variability information , availability of institutions to inform them on varying climatic conditions, and availability of water for use during dry seasons. All these factors are important in determining women's vulnerability to climate variability in Chepseon sub location.

This study will therefore be directed towards building women's resilience to climate variability by addressing the three objectives of the study which will be useful in recommending suitable adaptation and coping strategies to be adopted by women to counter the effects of climate variability.

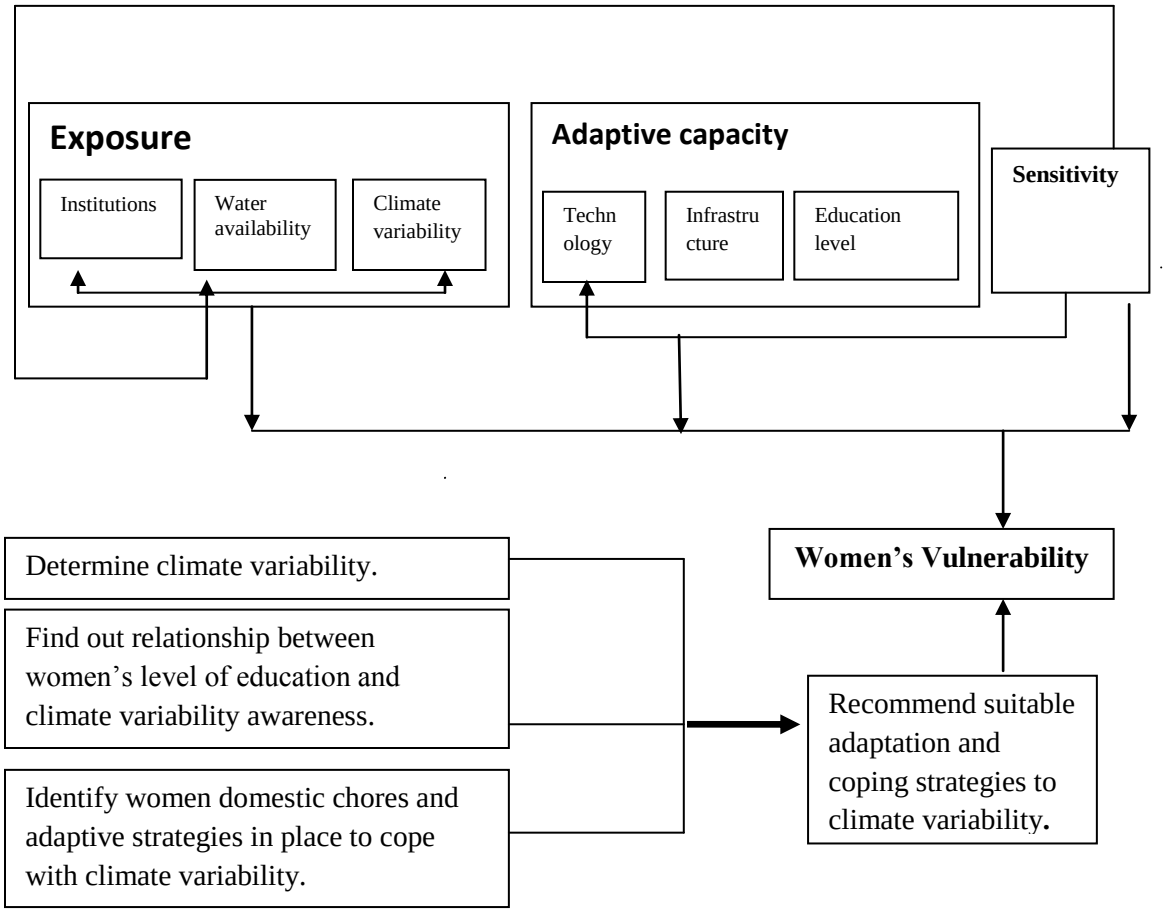

Figure 1.1: Women's domestic chores vulnerability to climate variability. **Source:** Author.

1.8 Definitions of Terms

Adaptive capacity: refers to the ability of a system to adjust to climate variability and extremes in order to moderate potential damages, to cope with the consequences or to take advantage of opportunities.

Climate change Awareness: A synthesis of people's conception, interpretation and perception of climate related issues which affect their behavior, and quality of responses and reactions to the problems.

Climate variability: fluctuations in elements of climate such as rainfall, temperature and may be caused by either natural process or anthropogenic activities.

Domestic chores: Domestic task or a duty to be accomplished in the household to meet all the needs of the family.

Exposure: refers to the degree to which a system is unprotected from the effects of changing climate.

Gender equality: refers to equal rights, responsibilities and opportunities of men and women and girls and boys.

Resilience: refers to the ability of a system to resist, absorb and recover from the effects of climate variability in a timely manner.

Sensitivity: refers to the degree to which the community is affected by climate variability.

Vulnerability: is the characteristic of a person or a group of people in terms of their capacity to anticipate, cope with, resist or recover from the impact of natural hazard. Vulnerability of an individual depends on his/her adaptive capacity, sensitivity and exposure to changing climatic conditions.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Climate change is the most severe problem that we are facing today: more serious even than the threat of terrorism (King, 2004). Over the recent decades climate change and global warming have become issues of global concern. According to Leggett (2007), earth's temperatures have risen by 0.6 to 0.9 ˚C since the industrial revolution, an observation that has made almost all scientists agree that climate is changing. While climate change existed even in the pre-industrial era, recent trends have raised global concerns as the change threatens the achievement of sustainable development. Although natural forces such as solar irradiance and volcanic activity contribute to climate change, anthropogenic activities are to blame for the current trends on climatic patterns (McMullen and Jabbour, 2008).

2.2 Anthropogenic Causes of Climate Change

According to Forster *et al.* (2007), there are four principal GHGs that are produced by human activities and are responsible for global warming. These are:

a. **Carbon dioxide (CO_2):** This has increased from burning of fossil fuels, deforestation, charcoal burning, cement manufacture and decay of plant matter.
b. **Methane (CH_4):** This is primarily produced by anaerobic processes such as animal digestion, landfills and rice cultivation. It is also produced during coal mining and natural gas handling.
c. **Nitrous oxide (N_2O):** emitted by nitrogen fertilizers, fossil fuel burning and combustion of solid wastes. However, natural processes in the soils and oceans also release N_2O.
d. **Halocarbons**: These are groups of gases containing fluorine, chlorine or bromine. They are produced by aerosol propellants, refrigerator coolants and air conditioners. Their presence in the atmosphere causes stratospheric ozone depletion. The principal halocarbons include the chlorofluorocarbons e.g. CFC-11 and CFC- 12.

Presence of these GHGs in the atmosphere allows the sun's short wavelength radiation to pass through to the earth's surface. Once the radiation is absorbed by the earth and re-emitted as longer wave-length radiation, GHG trap the heat in the atmosphere causing some warming effect (UNDP, 2009). According to IPCC (2007), global atmospheric concentration of CO_2 increased from a pre- industrial value of about 280ppm to 380ppm in 2005 making it the most important anthropogenic GHG compared to other GHGs. However, the annual CO_2 concentration growth rate was large during the last 10 years (1995-2005) with an average of 1.9ppm per year. According to scientists, there is likelihood that if GHGs concentration continues unabated, it will rise the global average temperature above natural variability by at least 1.5 ˚C during the 21st Century (above 1990 temperatures). However, there is a small likelihood that the temperature rise may exceed 5 ˚C (Leggett, 2007). These GHGs remain in the atmosphere for decades to thousands of years and are well mixed around the globe; hence their warming effects are largely global.

2.3 Effects of Climate Change

Climate variability is evident as changes in precipitation and temperature which tends to affect human means of subsistence, earth's ecosystem stability, structure and function (Lovelock, 2009). According to Canadell *et al.* (2007), global warming is an indication that we are overloading the carrying capacity of the earth's atmosphere with GHGs. If GHGs emissions are stabilized at the moment, warming is expected to continue for quite a long period of time because of climate processes and feedbacks. Effects of climate change include: increased exposure to coastal flooding, desertification, outbreak of climate related diseases, decrease in agricultural production and collapse of ecosystems (IPCC, 2007).These effects vary across the globe and will manifest itself differently among different social classes, income groups and sexes (Ahmed, 2008). These will be felt much in less developed countries and among poor people who are mostly dependent on natural resources for their survival (IPCC, 2001). According to Mitchell *et al.* (2007), women and girls make up a disproportionate number of the poor as argued in gender analysis of climate change. As compared to men, women and girls have fewer

capabilities and resources. These undermine their capacity to adapt to existing and predicted impacts of climate change (Justina and Esplen, 2008).

2.4 Climate Change in Africa

In Sub-Saharan Africa, climate change poses a serious threat to social and economic development (Thornton *et al.*, 2009). The development challenges of the region will be significant because African economies are dependent on climate-sensitive natural resources and that they have limited capacity to cope with its impacts (AMCEN, 2011). According to IPCC (2007), there is evidence that Africa is warming faster and is likely to continue and by the year 2100, temperature changes will fall into ranges of about 1.4 ˚C to almost 5.8 ˚C above the 1990 levels and 10 to 90cm rise in mean sea level.

2.4.1Consequences of Climate Change in Africa

According to World Bank (2010), the principal consequences of climate change in developing countries include:

i. Eroding resources away from development: Many of the world's poorest areas are in Africa. Out of the poorest 49 countries in the world, 33 are in Africa (UNDP, 2009). The degradation of the natural resources is likely to affect poverty trajectories, given that the poorest are those that utilize natural resources the most. According to estimates by World Bank (2010), by the year 2050 developing countries will have an additional 2.5 billion people. A large population will create additional demands on land, water, energy and natural resources.

ii. It will reduce agricultural productivity leading to hunger and malnutrition:
Agriculture is particularly vulnerable to climate change. According to Pierce *et al.* (1996), studies indicate that Africa's agriculture is negatively affected by climate change. This will threaten global agricultural productivity and hence food security (Nelson *et al.*, 2009). Although the overall impacts of climate change on agriculture are expected to be negative, there will be some gains in some crops in some regions of the world. Climate change will affect rainfall, temperature and hence water available for agricultural activities. The rise in temperatures will influence crop yields by shifting optimal crop growing zones, change of endemic zones for pests and diseases, changing patterns of

precipitation in terms of quantity and variability, crop yield and reducing arable land through sea-level rise and vulnerability to flooding (Wakhungu and Elvin, 2010). Shrinking water and land resources, increasing biodiversity losses and soil degradation due to climate change will endanger food security. It is projected that by the year 2080 around 1300 million people could be at risk of hunger due to climate change (Parry *et al.*, 2005). Climate change impacts in the four dimensions of food security: availability, stability, access and utilization (FAO, 2008).

a) Food availability: climate change impacts on soil fertility, water holding properties and hence crop yields reducing the amount of food available for consumption.

b) Food stability: Crop yields fluctuate with climate variability (particularly rainfall and temperature). Droughts and floods are a threat for food stability and can bring in transitory and acute food insecurity. Droughts and floods are expected to be more intense and less predictable.

c) Food accessibility: This refers to a situation whereby food is allocated through markets and non-market distribution mechanisms. Food affordability is determined by the relationship between household income and the cost of food. It would be negatively affected by climate change as production declines, food prices rise and purchasing power decreases.

d) Food utilization: climate change poses threat to food utilization through effects on the spread of diseases in geographical areas which were previously not affected and on human health. By the year 2080, agricultural output in developing countries may decline by 20% due to climate change. This will increase hunger and malnutrition due to food shortage. Decline in food production due to climate change can be avoided through irrigation, watershed management, improved land cultivation and development of crop varieties that are resistant to climate change. Women are particularly vulnerable to food insecurity because they are responsible for agricultural production in developing countries (UNDP, 2009).

iii. Climate Change and Human Health

Confalonieri *et al.* (2007) states that climate change is likely to cause health problems which include: higher rates of malnutrition (especially in young children) due to food shortages, increase in the prevalence of malaria in South and East African highlands,

increased respiratory diseases where air pollution worsens and increases in heat related mortality. The rising water levels associated with climate change will also lead to an increase in water borne diseases. According to Bartlett (2008), Children under the age of five are the main victims of sanitation-related illnesses and the elderly are mostly affected by heat stress. As water collectors, women face high exposure to water borne diseases such as cholera and dysentery (Denton, 2002). Women and girls are expected to care for the sick and children particularly at times of environmental stress and disasters. This increases women's vulnerability to climate variability.

iv Climate Change and Poverty

According to Ahmed (2008), it is the poor communities that are expected to be largely affected by climate change because of their limited access to financial resources and climate change information. Out of 49% of people in Sub-Saharan Africa living on less than one US dollar a day, over 60% are women (UNDP, 2009). This limits their ability to adapt to climate variability. Domestic chores ascribed to women limits the time they have available for income generating activities (Araujo *et al.,* 2007). When this is coupled with the rising medical costs associated with family illness resulting from climate change, it heightens levels of poverty. In areas prone to drought time absorbed by water and fuel wood collection will increase as women and girls have to travel for long distances in search of these precious commodities. More frequent floods that are projected to result from climate change in many areas will also increase women's workloads, because more time will be taken up cleaning and maintaining houses after flooding. This will have greater financial implications for household viability especially female-headed household which lacks the contribution of an adult male earner (Justina and Esplen, 2008). Lack of time to carry out income generating jobs makes women particularly vulnerable to climate change.

v. Climate Change and Natural Resources

a Impact of Climate Change on Water

IPCC (2001) acknowledges that climate change will have significant impact on water availability and quality in most African countries. Water is a key resource for human development especially in the rural areas of the developing countries. Water is a critical

component of most domestic activities such as farming, gardening, raising livestock and many other activities that contribute to the livelihoods of the rural poor. According to Hannan and Anderson (2001), women are the primary caretakers of water in majority of households in the rural areas of developing countries that is under pressure of growing competition due to climate change. Increased precipitation results in flooding increasing the spread of water borne disease while decreased precipitation, will increase drought conditions which will lead to water shortages. This will have an impact on livelihoods that largely depend on water availability such as agricultural production and on women's domestic chores.

b. Impact of Climate Change on Forestry

According to FAO (2011), forests and woodlands cover an area of about 23% of Africa's land area and about 17% of global forest area. While forests underpin the economies of many African countries, they enhance the quality of the environment and are at risk of climate change. However, different species of trees respond differently to climate factors. This will therefore affect the livelihoods of forest dependent communities as well as on national economic activities that depend on forest, tree products and their services. Population growth, climate change, and poverty are the major factors that are leading to overexploitation of forest products (AMCEN, 2011). Vulnerability of forests to climate change is expected to have considerable negative impacts on the agricultural sector and could render useless significant regions of marginal agricultural land (Kowero, 2011). According to Sands (2005), developing countries use more wood fuel energy than developed countries. Forests remain the vital source of biomass fuel required in most developing countries. Extraction of fuel wood from these forests is one of the major causes of forest depletion in developing countries. Women in developing countries depend on forests for the provision of fuel wood which is a major source of energy for cooking and heating in rural areas of most developing countries. Climate change poses a serious threat to forests making women particularly vulnerable to climate change.

vi Climate Change and Irrigation

Climate change has caused an increased global concern because of the impacts it will have on different sectors of a countries' economy. Africa is mostly affected by climate change (IPCC, 2001).Temperatures are rising and precipitation reducing by 10%. This effect will be felt more in the developing countries (Gicheru *et al.*, 2006). This is because agricultural production remains the main source of livelihoods for more than 60% of the population and contributes 30% GDP in Sub-Saharan Africa (Nhemachena and Hassan, 2007). According to Gicheru *et al.* (2006), decrease in rainfall and increase in temperature is going to affect agricultural yields in Kenya because only 2% of cultivated area is equipped for irrigation and almost all farmers must rely on rain to grow their crops. Women in Africa are responsible for subsistence agricultural production making them particularly vulnerable to climate change especially if they are not equipped with irrigational facilities.

2.5 Climate Change in Kenya

Kenya acknowledges that the change in earth's climate and its effects are a common concern of mankind. In Kenya, this phenomenon is already unmistakable and intensifying at an alarming rate. This is evident from increases in temperatures countrywide and irregular rainfall (ROK, 2010b). According to UNEP/ROK (2000), Kenya used to experience major droughts every decade and minor ones every three to four years. The cycle has since changed to five years (UNEP/ROK, 2005) and finally to yearly (2007/2008/2009) which has necessitated distribution of 528,341.77 metric tones foodstuffs over the last five years to feed 3.5 million to 4.5 million people annually(ROK, 2010b). The major drought faced in Kenya was in the year 2009 that affected all regions which led to crop failure, hunger and starvation of millions of people countrywide after a poor harvest and rising commodity prices (Kenya Red Cross, 2009). This is shown in Table 2.1.

Table 2.1: Number of people in Kenya requiring relief in the worst flood and drought disasters since 1971

Year	Type of disaster	No. of people affected
2009	Floods	750,000
2009	Drought	3,800,000
2006	Floods	723,000
2006	Drought	3,000,000
2005	Drought	3,500,000
2003	Floods	45,000
2002	Floods	60,000
2001	Drought	3,400,000
2000	Drought	2,740,000
2000	Floods	125,000
1998	Floods	539,000
1997	Floods	212,000
1993	Drought	1,200,000
1992	Drought	2,700,000
1984	Drought	600,000
1979	Drought	40,000
1971	Drought	130,000

Source: Herrero *et al.* (2010).

Intensive rainfall periods often follow droughts. Rainfall that is normally experienced during wet months translates into high stream/river flow in permanent and intermittent rivers in the country that result into seasonal floods (Otiende, 2009). Floods often result into economic and financial losses (Karanja *et al.*, 2002).The worst droughts that were experienced in Kenya in the last 60 years were in the year 2005 and 2009. According to Osbahr and Viner (2006), magnitude and frequency of people affected increases with

increase in flood events. The most significant floods in terms of number of people displaced in Kenya was in the year 2003 as shown in table 2.2.

Table 2.2: Areas and number of people affected by floods in Kenya (1997-2009)

Year	Regions Affected (provinces)	Number of people displaced	Fatalities
2009	Nyanza (Kisumu Town)	150 families	5
2008	Nyanza, Northeastern, Rift Valley, Coast	12,000	5
2007	Western, Nyanza	20,610	9
2006	Nyanza, Western, Coast and Eastern	723,000	66
2005	Western, Nyanza, Eastern and North Eastern	35,000including 25,000 refugees in Dadaab	20
2004	Widespread	2,500	50
2003	Western and Eastern	1,000,000	77
2002	Western, Nyanza, Eastern, Coast	150,000	14
2001	Nairobi	Missing data	4
1997-1998	Widespread	1,500,000*	53

*Figure includes people affected in the 4 East and Horn of Africa Countries including Kenya, Somalia, Ethiopia and Tanzania including over 2000 deaths.

Source: Otiende (2009)

According to Indenje *et al.* (2000), major floods periodically afflict the Winam Gulf of the Lake Victoria, the Lower Tana River basin and the Coastal regions. Flooding displaces many people and destroys property. Compared to droughts, floods affect relatively few people in the country. This is because drought affects agricultural production leading to food insecurity that is widespread over a larger area (FAO, 2008). In Kenya, agriculture sector is sensitive to variations in rainfall and accounts for about 26% of GDP and 75% of jobs (Herrero *et al.*, 2010).

There has been a general increase in temperature trends from the early 1960s in Kenya over vast areas (ROK, 2010b). This is shown in table 2.3.

Table 2.3: Minimum temperature trend from 1960-2010 in Kenya

Region	Trend	Magnitude (˚C)
Western	Increase	0.8-2.9
Northern & North-Eastern	Increase	0.7-1.8
Central	Increase	0.8-2.0
South Eastern districts	Increase	0.7-1.0
Coastal strip	Decrease	0.3-1.0

Source: ROK, 2010b.

From table 2.3, there has been a positive trend (increase) in minimum temperatures over vast areas of the country indicating a general warming trend with time. However, the coastal strip showed a negative trend (decrease) in minimum temperatures indicating a general cooling trend with time. Maximum temperatures have also shown a positive trend since 1960 over vast areas of the country as shown in table 2.4.

Table 2.4: Maximum temperature trend from 1960-2010 in Kenya

Region	Trend	Magnitude (˚C)
Western	Increase	0.5-2.1
Northern& North-eastern	Increase	0.1-1.3
Central	Increase	0.1-0.7
South Eastern districts	Increase	0.2-0.6
Coastal strip	Increase	0.2-2.0

Source: ROK, 2010b.

vvFrom tables 2.3 and 2.4, there has been a general warming in the country an indication of changing climate.

2.5.1 Impacts of Climate Change in Kenya

Impacts of climate change have been evident in various sectors of economy which includes agriculture, forestry, livestock, tourism, transport, energy sector among others. In agriculture sector, the production of major crops like tea, sugarcane and wheat has declined which could reduce Kenya's foreign exchange earnings in the long run (Herrero

et al., 2010). According to ROK (2010b), frequent and severe drought, which have been experienced since 1990s have reduced forage in rangelands and the volumes of rivers consequently affecting survival of wild life. Rainfall determines the distribution of forest resources. Kenya's forest survival will be severely affected by climate change.

2.6 Climate Change and the Millennium Development Goals (MDGs)

Climate change threatens to undermine international efforts to combart poverty (UNDP, 2007).This is an agreement made by all countries and development organizations in the world aimed at promoting development through targets to be achieved by the year 2015. However, climate change may impede the attainment of the MDGs and therefore harm human development. There are eight millenium development goals. These are to:eradicate extreme povery and hunger, achieve universal primary education, promote gender equality and empower women, reduce child mortality, improve maternal health,combat HIV/AIDS, malaria and other diseases, ensure environment sustainability and develop a global partnership for development (UNDP, 2010).The major aim for these development goals is to fight poverty, inequality and to accelerate human development especially in the developing world. According to IUCN (2007), climate change pose a serious threat to the achivement of the MDGs (see Appendix I).

2.7 Millennium Development Goals in Kenya

The first Millenium Development Goal is to eradicate extreem poverty and hunger. According to ROK (2005),in the year 2003, 56% of the Kenyan population was still living below poverty line. With the current trend of climate change, a projection of 65.9% of the Kenyan population will be living below the poverty line by the year 2015 (ROK,2005). This makes it difficult to achieve the first Millenium Development Goal. The poor communities are characterized by limited access to financial resources and climate change information making them largely affected by climate change (Ahmed, 2008).

Regarding education, Kenya is likely to achieve the goal of universal primary education by the year 2015 since the enrolment, retention, completion rates of both boys and girls is

almost equal. However the main problem comes in the tertiary institutions where the ratio of the enrolment of girls to that of boys continues to be low. However , with the onset of climate change, the rate of dropping out of girls will be higher than that of boys. This is because girls will help their mothers in carrying out domestic chores such as collecting water from a far away distance (UNDP, 2009). This will limit time available for education , understanding of climate science and the impending effects of climate change.

ROK (2005) states that, majority of African countries are seriously off track in the achievement of Martenal health and reducing child mortality rates goals. This is because of the challenges posed by climate change.There was a reduction in infant mortality rate during the period 1960-1990 from more than 100 deaths per 1,000 live births to about 60 deaths per 1,000 live births in Kenya. This trend was reversed and infant mortality rate increased to 71 deaths per 1,000 live births during 1993-1998. While marternal mortality rate stood at 590 deaths per 100,000 live births during 1989-1998.

Climate change has posed a major challenge on health of our nation. The likely health consequences of climate change includes increase in the spread of water borne diseases such as cholera and typhoid, higher rates of malnutrition due to food shortages, increase in spread of malaria, increase in spread of respiratory diseases due to air pollution and increased heat- related mortality and morbidity. Children under the age of 5 years are the victims of sanitation- related illnesses (Bartlett, 2008).This threatens the achievement of the 6^{th} MDG i.e. to combat HIV/AIDS, malaria and other illnesses.

Gender is a cross-cutting dimension of the various MDGs. The 3^{rd} MDG is to promote gender equality and to empower women. This is recognized as an important driver in tackling poverty, hunger, disease and achieving the other MDGs. This goal targets to eliminate disparity in primary, secondary and at all levels of education by the year 2015. It also targets to remove disparity in share of women and men in wage employment in non-agricultural sector and representation in the government. Cultural barries and conflicts continue to propagate inequality for women and girls threatening their health, safety, limiting their decision making power and leading to inequitable access to resources, education and employment opportunities (UNDP, 2010). Women are

vulnerable to climate change than men not because they are 'naturally weaker', but because they face different conditions of vulnerability. Women often live in conditions of social exclusions such as limited mobilization outside their immediate environment, limited access to forecasts of climate variability and have less access to information on early warning systems in times of disasters (UNIFEM and DAW, 2001). Climate change therefore threatens the achievement of millenium development goals in Kenya.

2.8 Women's Vulnerability to Climate Variability

Vulnerability refers to the characteristics of a person, system or groups of people or a region to predict, manage, resist or recover from the impact of a natural hazard (Care International, 2009). Vulnerability of a system to climate variability depends on its adaptive capacity, sensitivity and exposure to changing pattern of climate. According to Deressa *et al.* (2008), adaptive capacity of a system is determined by the availability of resources for protection, survival or coping when climate variability occurs. Indicators that are used to determine adaptive capacity include: availability of infrastructure and institutions to inform on climate variability, access to and use of technology, level of education, availability of irrigation facilities and access to credit facilities. According to IPCC (2001), exposure to climate variability is the degree to which a system is unprotected from impacts of climate variability and indicators used are: access to climate variability information over the radios and internet, availability of water, varying climatic conditions. Women are the major actors in rural livelihood activities around the globe. Their roles vary from those of men within different communities, countries and regions. Although rural women play a significant role in economic survival of their families, they have limited access to productive resources such as land, health care, education and decision-making (UNIFEM and DAW, 2001).This increases women's vulnerability to poverty and hence climate variability.

Women in African countries are not involved in decision-making, hence gender dimensions of climate change are not put into consideration. Their voices have been muted at all levels thus increasing their vulnerability to climate change(UNDP, 2009). According to Brody *et al.* (2008), boy's education in developing countries is prioritized

than girl's education. When there is shortage of resources e.g. finances, girls will be the first ones to be pulled out of school. They also get out of school to help their mothers in fetching water and fuel wood when there is scarcity. This will limit their access to crucial information and when they get this information, they have limited means to interpret it. Women's lack of education and expectations from communities limits them from entering into formal workforce. This limits them from receiving loans from financial institutions that would help in diversifying their income sources.

2.9 Climate Variability Awareness

Awareness on climate variability can play a big role in mitigating and adapting to its impacts. According to Brody *et al.* (2008), priority is still placed on boys' education rather than girls' education in developing countries. Girls are likely to be the first ones to be pulled out of school when resources run short (Appleton, 1996). As a result they receive fewer years of education than boys. Women and girls often do not have the opportunity to enter into formal workforce because of their time- consuming domestic responsibilities. This makes them come to close contact with natural resources on daily basis hence can be able to detect variability in climatic conditions in their environment. However, their lack of education will limit their access to crucial information and when they get this information they have limited means to interpret it (UNIFEM and DAW, 2001).

2.10 Related Studies on Women's Vulnerability to Climate Variability

United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol have not paid any attention on the linkages between gender and climate change. IPCC (2001) declares that vulnerability to climate change varies within countries, communities, gender, age, income groups and households. Some groups have been identified to be particularly vulnerable including people dependent on rain-fed agriculture for their livelihoods, women, pastoralists and landless people. According to a study done in Bangladesh on gender, climate change and vulnerable groups by CCC (2009), 12 study sites from all over the country were chosen to represent diverse geo-physical realities. One of the specific objectives was to find out who would be the most vulnerable group

among men and women under climate change. The tools for data collection included key informant interviews and Focused Group Discussions. The results of the study indicated that women were more vulnerable to climate change than men. This represented too large study sites. The results of the study were limited in that it only represented vulnerability of women and men in Bangladesh.

According to ROK (2010b), Kenya is vulnerable to climate change because most of her people depend on climate sensitive natural resources for their daily activities. However, vulnerability of various groups and regions need to be determined.Vulnerability of various groups and regions in Kenya differ. Some groups e.g women and children in society are more prone to damage, suffering and loss associated to climate change. Women are vulnerable to climate variability because of their close relationship with natural resources. The aim of this study was to fill the gap of determining vulnerability of women's domestic chores to climate variability in Chepseon Sub-location because according to the available literature similar study had not been done in Chepseon sub-location.

CHAPTER THREE: METHODOLOGY

3.1 Study Area

The study was carried out in Chepseon Sub Location of Nakuru County. It is located within a latitude of 0.03 (00° 01' 60'' N) and a longitude of 36 (36°00' 00'' E). A square kilometer has an approximate population of 115 persons and average altitude of 1912m above the sea level. Agricultural land use includes ranching, dairy cattle farming, maize, wheat, millet, beans and some sisal production (Anthony, 2011).

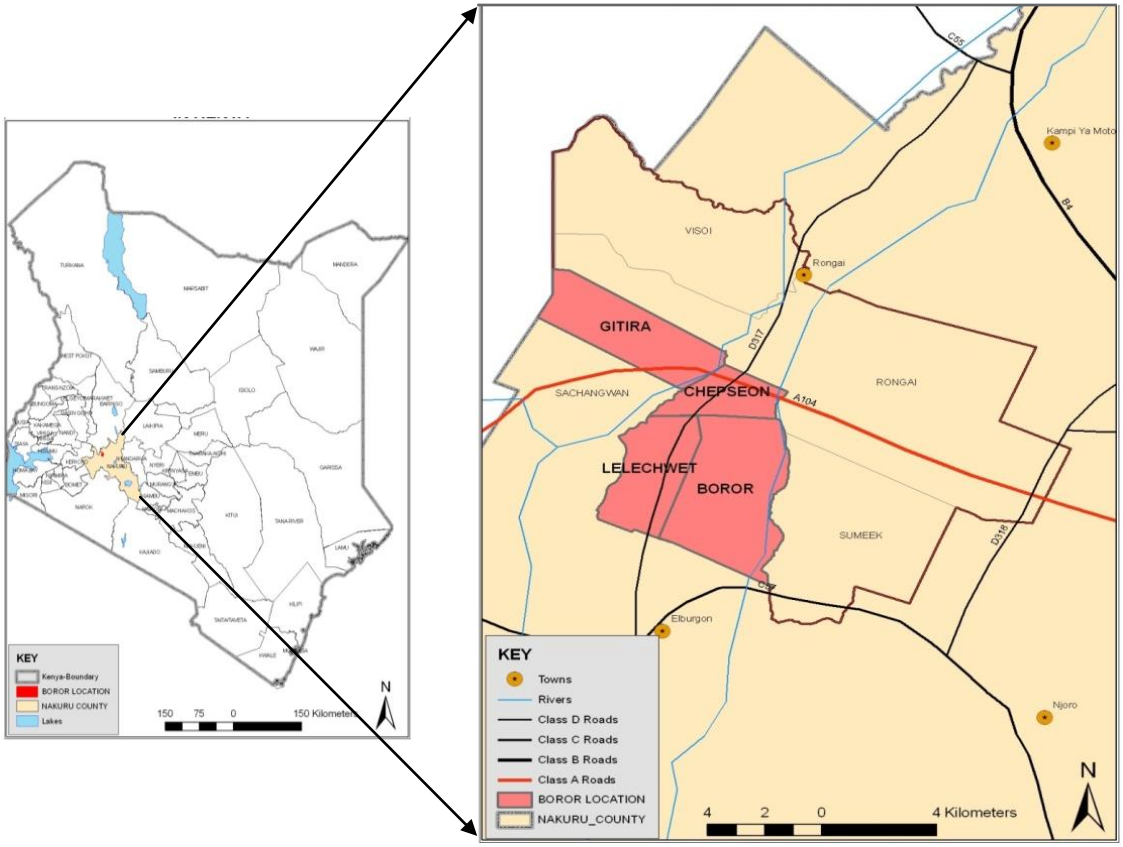

Figure 3.1: Study Area Map. **Source:** Anthony (2011).

3.2 Research Design

Descriptive research design was used in this study. It is a process of collecting data in order to answer questions concerning the current status of the subjects in the study. It seeks to provide an accurate description of observations of phenomena.

3.3 Population of the Study

The population of study was composed of 897 households. Lists of all household heads were obtained from assistant chiefs of all the 5 villages under study. 10% of the total household population was taken as a sample to represent the entire sub location with one woman from each household being the respondent. The Sub location consisted of five villages. These were Chepseon, Boror, Moyaset, Lelechwet and Gitira farm of Deloraine estate. Other key informants included Nakuru District Environmental Officer, Nakuru District Agricultural Officer and representatives from Social and Economic Women Organizations in the region. They were important in providing in-depth information as follows: Nakuru District Environmental Officer was important to the study because he oversaw sustainable use of natural resources in the entire district while Nakuru District Agricultural Officer provided information on access to subsidized agricultural inputs by women in Chepseon Sub location. Three women groups i.e. Silver Ladies, Kas ak Icham and Rongai Social and Economic Women Organization (ROSEWO) were taken to represent social and economic organizations that were available to provide credit facilities (through giving loans to be repaid with 5% interest) to women members in the sub location. They also did merry go rounds to enhance and sustain the groups. Rongai Social and Economic Organization and Kas ak Icham groups were registered while Silver Ladies was still in the process of being registered.

3.4 Sampling Procedure

The population under study was composed of 5 villages (assumption being they were the most vulnerable to the effects of climate variability). Each village represented one stratum. Therefore there were 5 categories of strata. Stratified random sampling procedure was used in selecting the sample of the study. The desired sample size was therefore, 10% (90 households) of the entire population (897). To arrive at exact number of households in each village to be included in the sample, specific number of households per village were taken divided by the total number of households in the entire sub-location and multiplied by the sample size taken i.e. **N/T×90**

Where: **N** represented number of households in a particular village, and **T** represented total number of households in the study area. The number of households in each individual village included in the sample is shown in table 3.1.

Table 3.1: Number of households included in the sample

Village	Stratum No.	Number of households	Number of households included in the sample (N/T×90)
Chepseon	1	147	15
Boror	2	254	26
Lelechwet	3	224	23
Moyaset	4	209	21
Gitira	5	45	5

Chepseon village was composed of 147 households, Boror village was composed of 254 households, Lelechwet village was composed of 224 households, Moyaset village was composed of 209 households and Gitira farm composed of 45 households. After obtaining the desired household numbers in each stratum, specific households to be included in the sample were selected using random sampling. This involved giving a number to every subject or member of the accessible population, placing the numbers in a container and picking them at random. The subjects that corresponded to the numbers picked were included in the sample.

3.5 Sample Size

90 households were taken to represent the entire sub location. 15 households were chosen from Chepseon village, 26 from Boror village, 23 from Lelechwet village, 21 from Moyaset village and 5 from Gitira village.

3.6 Instrumentation

Open-ended and closed-ended questions were administered to collect data for the study. Questionnaires on women's domestic chores vulnerability to climate variability had three sections: Section A consisted of general questions about the respondent, Section B consisted of questions on climate variability awareness among women in Chepseon sub location and Section C consisted of questions on adaptation, sensitivity and exposure of women's domestic chores to climate variability. Questionnaires on access to credit and saving facilities by women were administered to Chairladies of: Rongai Social and Economic Women Organization, Silver Ladies and Kas ak Icham women groups (one questionnaire each). Data collected from Nakuru District Agricultural Officer included: Awareness on climate variability, its effects on Agricultural production and access to subsidized farm inputs by women in Chepseon sub location. Data collected from Nakuru District Environmental officer included: awareness on climate variability, its effects on natural resources and sustainable resources use by women in the district.

3.7 Data Collection Procedures

3.7.1 Pilot Study

A pilot study was conducted to test the suitability of the questionnaires. Five women from the study area were randomly selected and interviewed. This excluded the ones from which data were collected. Assistant Agricultural Officer and assistant Environmental Officer were also interviewed. Results from the pilot study were used to correct vague questions in order to collect relevant data to answer research questions. They were also analysed to check if the method of analysis suggested was appropriate.

3.7.2 Data Collection

Monthly temperatures and precipitation data for Nakuru Meteorological Station (Station number: 9036261) were collected from Kenya Meteorological Department in Nairobi for a period of 30 years (1982 to 2011). Thirty year duration was chosen because it was long enough to have substantial data to determine climate variability in Chepseon sub location. Questionnaires were administered to collect data on climate variability awareness and adaptive capacities that women had in place to cope with climate variability.

3.8 Data Analysis

Questionnaires were examined for consistency. The responses were numerically coded and analyzed using Statistical Package for Social Sciences (SPSS) computer software. Results were discussed and presented as descriptive statistics in tables and graphs. Temperatures and precipitation were analyzed for significant variability. Chi- square test was done to establish the relationship between women's level of education and climate variability awareness. Pearson's product moment correlation was also done to establish the relationship between women's age and family size in Chepseon sub location. ANOVA F-test was used to determine whether there was a significant difference between women's age in the 5 villages of Chepseon sub location.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Introduction

The aim of this study was to find out whether women's domestic chores (cooking, farm work and collecting fuel wood) were vulnerable to climate variability in Chepseon sub location. Vulnerability was assessed in terms of their exposure, sensitivity and adaptive capacity. This chapter therefore presents findings of the study and answers the research questions posed by the study at the outset.

4.2 Characteristics of Respondents

This part presents information about the respondents' age, village they came from, level of education, sources of income, professional training, family size and their domestic chores.

4.2.1Women's Age and Family Size

Ninety women were sampled from Chepseon sub location in order to determine their age. F-test was done to determine whether there was a significant difference between the mean ages of women in the 5 villages of Chepseon sub location. Results showed that there was a significant difference in the mean age of women in the 5 villages of Chepseon sub location ($F = 2.85$, $df = 4, 89$; $p = 0.028$).This is shown in table 4.1.

Table 4.1: Mean age (yrs) and standard deviation for women in Chepseon sub location

Village	Mean(yrs)	Frequency	S.D
Boror	42.54	26	5.81
Chepseon	45.00	15	12.28
Gitira	36.00	5	24.14
Lelechwet	38.26	23	14.30
Moyaset	33.90	21	7.04
Total	**39.48**	**90**	**11.72**

From table 4.1, the mean age for women respondents in Chepseon sub location was 39.48 years. The mean age of women in Chepseon village (45.00 years) was the highest meaning that women in that village were the oldest followed by those from Boror village with the mean age of 42.54 years. Those in Moyaset village were the youngest with a mean age of 33.90 years. Moyaset village was a newly settled area and this could be the possible explanation for the young age exhibited by women in that village. Majority of women (47%) in Chepseon sub location were aged between 31-40 years as shown in table 4.2.

Table 4.2: Women's age bracket in Chepseon sub location

Age bracket(Years)	Frequency	Percentage (%)
21-30	19	21
31-40	42	47
41-50	17	19
51-60	7	8
61-70	2	2
71-80	3	3
Total	**90**	**100**

Majority of those living in the study area were therefore of young age who needed employment and training opportunities in order to upgrade their livelihoods. They needed programs aimed at laying platform for self employment. Pearson's product moment correlation (r) =0.302 showed that there was no significant relationship between women's age and their family size in Chepseon sub location. This showed that the age of women in the sub location did not determine their family size. The average family size in the study area was 6 members per household with an average of 4 children.

4.2.2 Education, Sources of Income and Professional Training

Majority of the respondents (53%) in the study area had received basic primary level education as shown in table 4.3.

Table 4.3: Women's level of education in Chepseon sub location

Highest Level of Education Completed	Frequency	Percentage (%)
Primary	48	53.33
Secondary	16	17.77
Tertiary	1	1.11
None	25	27.78
Total	**90**	**100**

From table 4.3, the number of those women who proceeded to the next level of education dropped sharply. The possible explanation for this could be lack of resources to take girls to the next level of education, early marriages and boy's education given more priority than that of girls. According to Brody *et al.* (2008), women's lack of education limits them from gaining access to crucial information and when they come across them they have limited means to understand and interpret them since they lack basic knowledge in climate science. Lack of education also limits them from entering into formal workforce. They are also unable to acquire certain skills that are important in building their resilience to the effects of climate variability. Women's lack of education and coping skills is the major reason that makes them more vulnerable to natural disasters such as drought and floods and hence increased incidences of mortality (Kamis and Saiful, 2006).

Women in Chepseon sub location had various sources of income. These included: self employment, retirement pension, formal employment, savings and investment. However,

some women had no regular source of income. Most women in Chepseon sub location earned their income from self employment. This is shown in table 4.4 below.

Table 4.4: Women's source of income in Chepseon sub location

Source of Income	**Frequency**	**Percentage (%)**
Self employed	47	52.2
Formal employment	12	13.3
Retirement pension	1	1.1
Savings and Investment	2	2.2
No regular source	28	31.0
Total	**90**	**100**

Those women who were self employed carried out businesses in Salgaa shopping center. These businesses included buying and selling of cereals and petty vegetable businesses which were vulnerable to climate variability hence affecting availability and prices of their commodities. Those that earned income from formal employment were majorly working in the flower farms which included: Red shank, Sharkish and Roseto. Their income ranged from Ksh. 1000.00- 5000.00 per month. However, the number of women with no regular source of income was high (31%). This meant that they were not financially independent and often faced a lot of challenges in receiving loans and any other forms of credit. According to Ryan et al. (2011), lack of direct access to financial resources limits women's ability to maximize benefits by investing in additional income generating activities. This limits their ability to adapt to climate variability. The amount of income per month earned by women in Chepseon sub location is shown in fig 4.1

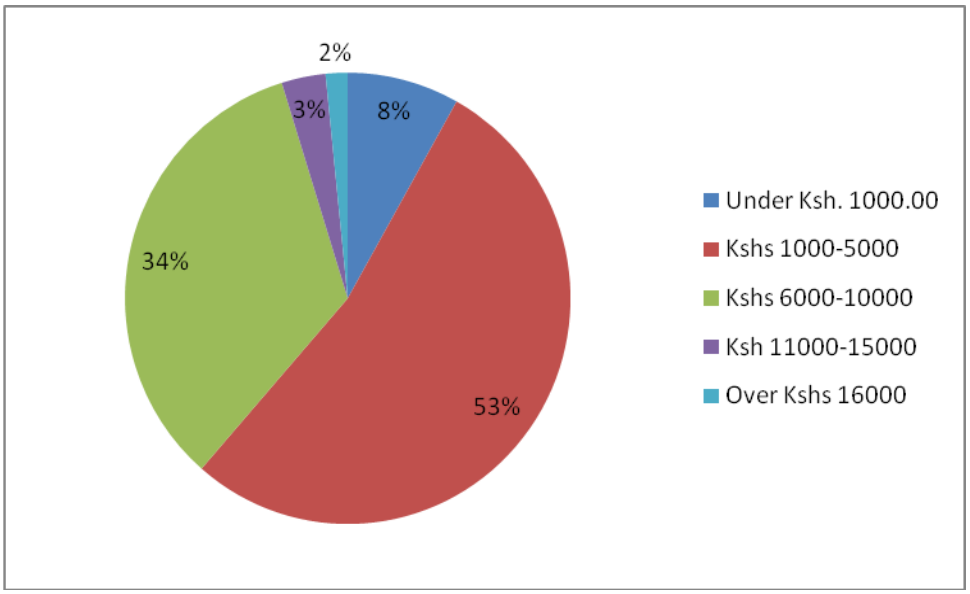

Figure 4.1: Women's income levels per month in Chepseon sub location

Majority of women(53%) earned income that ranged from Kshs. 1000.00-5000.00 per month. They stated that this amount could not meet their daily needs considering the fact that most of their husbands worked in the same flower farms and earned the same amounts of income per month. Those women who did not go to school, did not complete primary school, completed primary school and secondary school and worked together in the flower farms earned the same amounts of income. Lack of education did not mean that women could not have some source of income.

4.2.3 Size and Type of farmland

On average the households under study lived on 2.44 acres of land. Land is an important resource to women in the society. They have been assigned roles that largely depend on land as a resource. This provides the basis in which women carry out their domestic chores (Denton, 2002). The types of farmlands that women in Chepseon sub location lived on were private and leasehold as shown in fig 4.2.

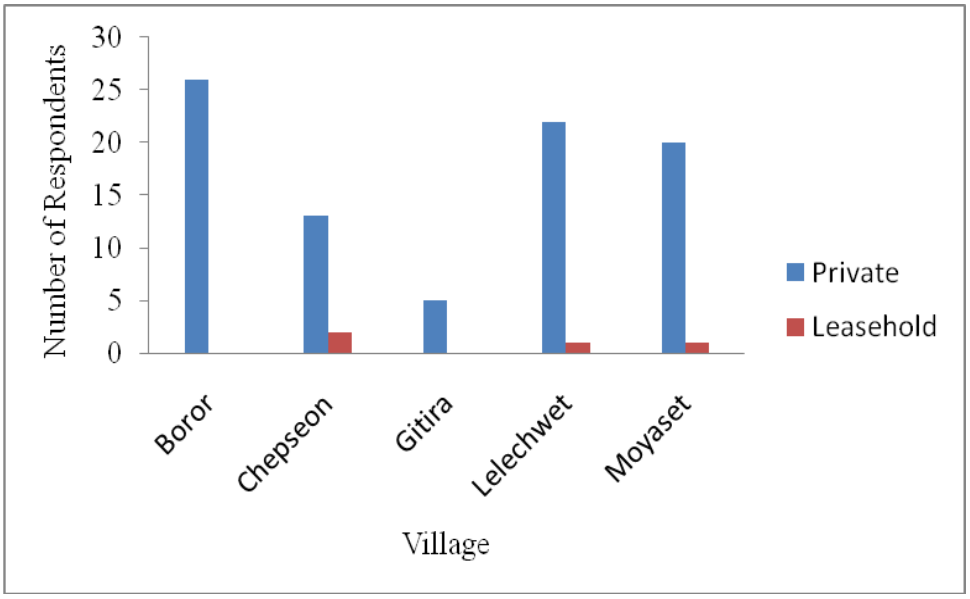

Figure 4.2: Type of farmland per village in Chepseon sub location

From fig 4.2, majority of women (96%) lived on privately owned land meaning that they had access to it, while 4% lived on leased land whereby they were not allowed to carry out any agricultural activity. According to Katharine and Lucy (2010), women might have access to land but have limited control over it. Most women in Africa do not own land and therefore do not make decisions over its use. This increases women's vulnerability to climate variability. Lack of ownership of such a resource also limits women's ability to access credit facilities such as bank loans to help them in adapting to climate change (McFerson, 2008). This is because land offers financial security and food security (Denton, 2002).

4.2.4 Women's Domestic Chores

Women in traditional African societies have been ascribed roles that they play in their families. According to this study, these roles were classified into 6 groups. These were: Cooking food, farm work which included weeding of maize, vegetables and beans fields, collecting fuel wood, fetching water, milking of cows, herding of cows, goats and sheep as shown in Fig 4.3.

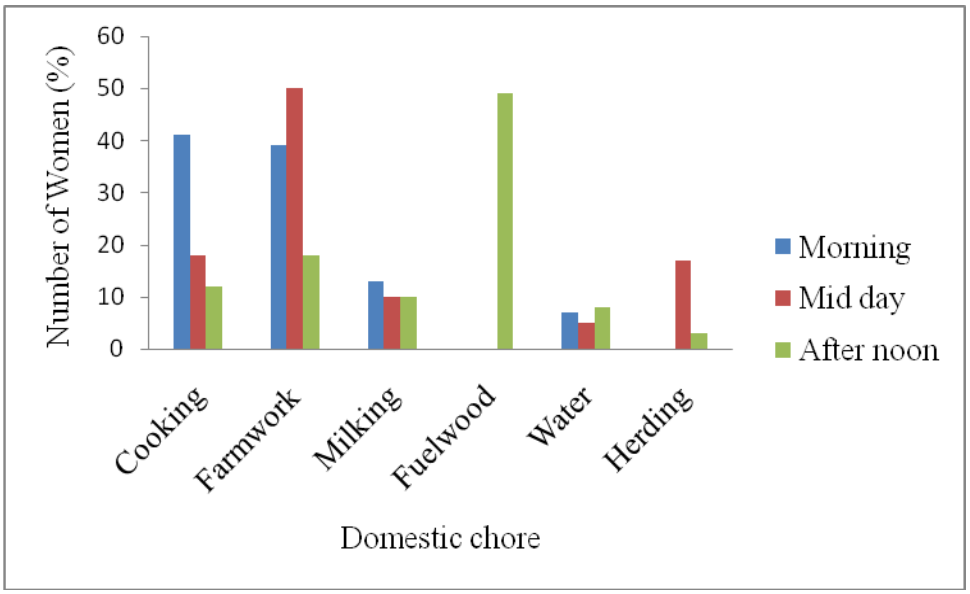

Figure 4.3: Women's domestic chores in Chepseon sub location.

From fig 4.3, cooking is an activity that dominates morning hours, farm work dominates mid day and fuel wood collection dominates afternoon hours. In rural African communities, women have been left with the responsibility of agricultural production, water collection for human and agricultural production, collection of fuel wood and herding (Mitchell *et al.*, 2007). Their close contact to natural resources makes them particularly vulnerable to climate variability. In an event of climate change, there will be reduced agricultural productivity, increased water scarcity and increased health risks (UNDP, 2007). This will increase women's burden in adapting to climate variability.

4.3 Determining Climate Variability in Chepseon Sub location

4.3.1 Precipitation Analysis in Chepseon Sub location from 1982-2011

Precipitation distribution and amounts of a particular place determines the availability of water for various functions (Gicheru *et al.*, 2006). These are: for crop use, domestic use and commercial use. Most of women's domestic chores involve use of water. These chores include: cooking, washing, subsistence farming and animal keeping. Limited amounts of precipitation therefore mean that most of women's domestic chores would be affected. To determine whether there has been variability in the amounts of precipitation

received in Chepseon Sub location, the total annual precipitation were calculated and presented in fig 4.4.

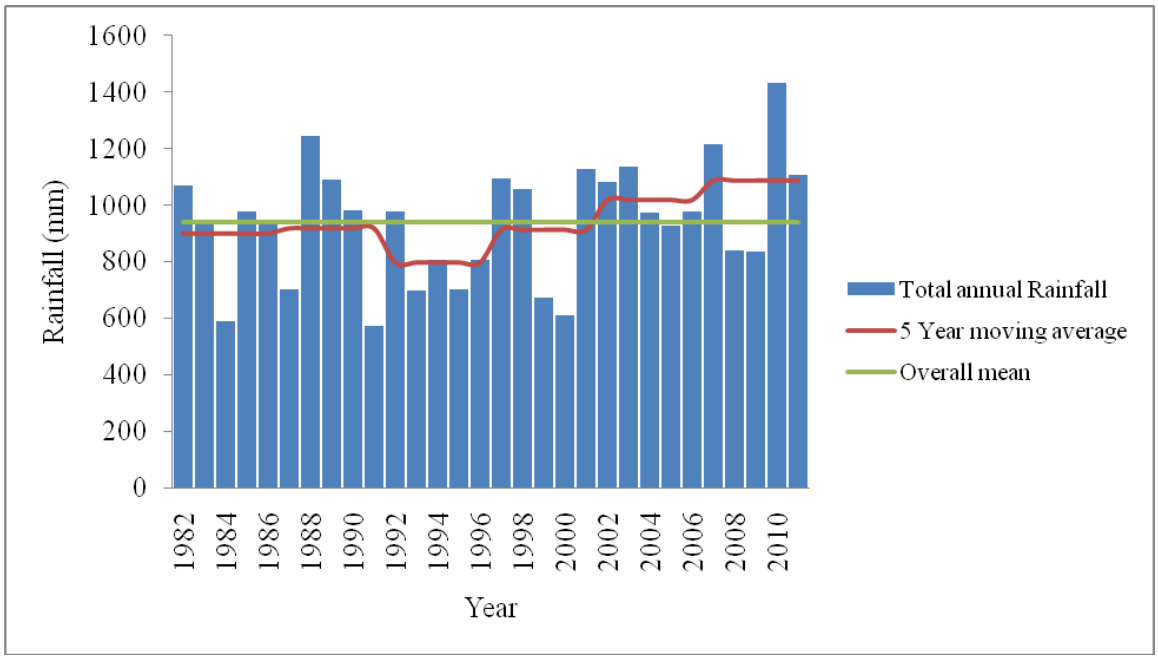

Figure 4.4: Precipitation flow using 5-year moving averages (1982-2011): Chepseon, Nakuru County. **Source:** KMD, Nakuru Station no: 9036261.

The graph shows a general increase in precipitation from1982 to 2011 whereby rainfall had increased over the years from 1071.5mm to 1106.5 mm. However, there were drastic changes in rainfall within the 30 year period, with the lowest amount of annual precipitation (573.2mm) recorded in the year 1991and the highest amount of total annual precipitation(1434.9mm) recorded in the year 2010. The mean for the 30 year period of time was 939.43mm. Five year moving averages were calculated and presented in table 4.5.

Table 4.5: Five- year moving averages for total annual rainfall (mm):1982-2011.Nakuru County**.**

Year	Average Rainfall (mm)
1982-1986	900.54
1987-1991	918.60
1992-1996	797.96
1997-2001	913.24
2002-2006	1018.98
2007-2011	1087.24

From table 4.5, in every five years, the average rainfall had greatly changed, with the first five years rising from 900.54mm to 918.60mm in the next five years then decreasing to 797.96mm in the next five years that followed. Average rainfall then rose to 913.24mm in the next five years. The last decade showed a significant increase in the average annual precipitation from 1018.98mm to 1087.24mm (Table 4.5 and fig 4.4). This trend showed variability of rainfall over the years which were also unpredictable. Deviations of precipitation from the 30 year mean are shown in fig 4.5

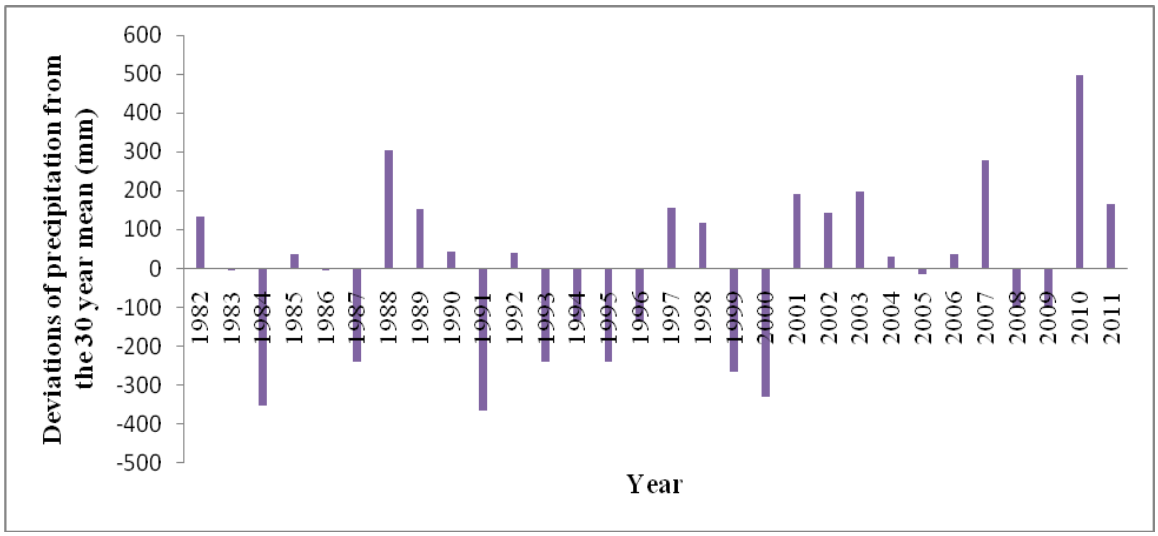

Figure 4.5: Deviations of precipitation from 30 year mean (1982-2011): Chepseon, Nakuru County. **Source:** KMD, Nakuru Station no: 9036261.

The year 2010 had the highest deviation from the mean of 495.47mm. This was the year in which the highest total annual precipitation of (1434.9mm) was recorded. In the year 1991, the lowest amount of precipitation (573.2mm) was recorded with deviation of -366.23 from the mean.

Total monthly precipitation results for the 30 year period of time showed increased variability from one month to another as shown in fig 4.6.

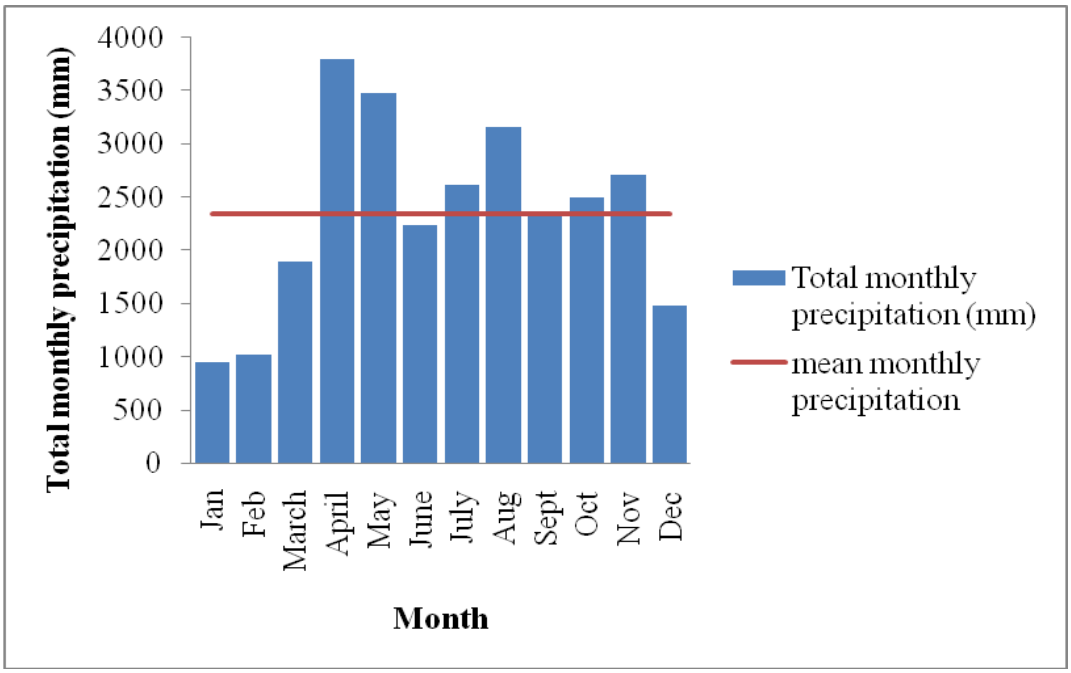

Figure 4.6: Total monthly precipitations (1982-2010): Chepseon, Nakuru County.
Source: KMD, Nakuru Station no: 9036261.

From fig 4.6, the highest amount of precipitation (3802mm) was recorded in the month of April and the lowest amount (945mm) recorded in the month of January in the entire 30 year period of time. The mean monthly precipitation was 2348.6 mm. However, there was increased variability in the total amounts of precipitation received from one month to another with sharp inclines and sharp declines. Sharp inclines were recorded in the months of March, April, July and August while sharp declines were recorded in the months of June, September, December and January. Deviations from mean monthly precipitation (2348.6mm) are shown in fig 4.7.

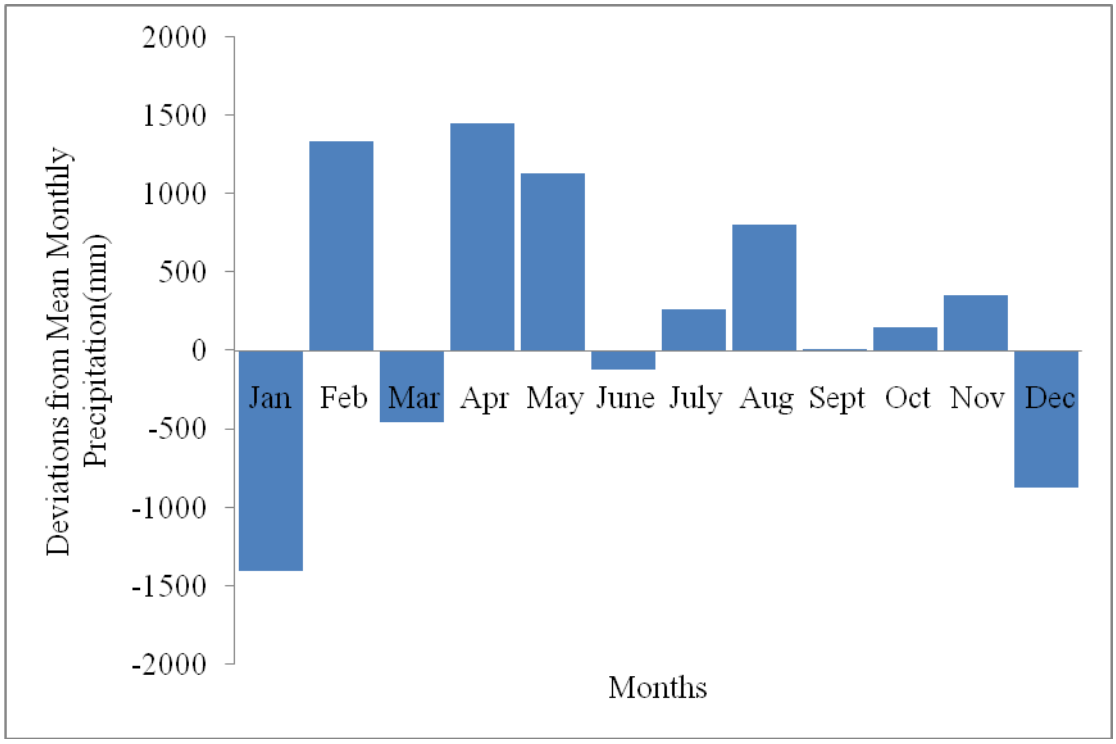

Figure 4.7: Deviations from mean monthly precipitation (mm) (1982-2011): Chepseon, Nakuru County. **Source:** KMD, Nakuru Station no: 9036261.

From fig 4.7, the lowest deviation from the mean (-1404mm) was recorded in the month of January. This was the month in which precipitation recorded was at its lowest (945mm). The Highest deviation from the mean was recorded in the month of April (1453.4mm) when the highest amounts of precipitation (3802mm) were recorded. This showed increased rainfall variability from the mean.

The results from the above analysis indicated an increased variability in the amounts of precipitation received in Chepseon sub location year after year and within the year. This indicated that Chepseon sub location was exposed to changes in precipitation amounts. Climate variability will affect availability of natural resource that women depend upon to accomplish their daily domestic chores.

4.3.2 Analysis of Average Temperature Trends in Chepseon Sub Location (1982-2011)

In general, average temperatures have been falling from January (18.845˚C) to December (18.185˚C) in the entire 30 year period of time. However, variability in average temperatures was also recorded one month after another as shown in fig 4.8.

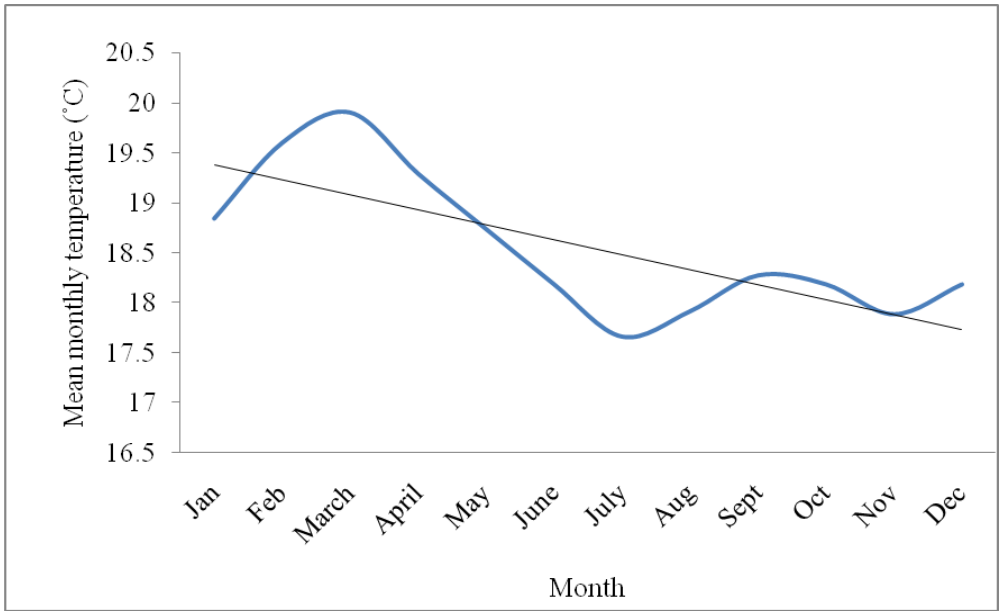

Figure 4.8: Average temperature trends for Chepseon sub location (1982-2011): Chepseon, Nakuru County. **Source:** KMD, Nakuru Station no: 9036261.

From fig 4.8, the highest average temperature of 19.91˚C was recorded in the month of March and the lowest of 17.66˚C was recorded in the month of July.

4.3.2.1. Variability of Annual Mean Maximum Temperature for 30 Year period for Chepseon Sub location

Generally, annual mean maximum temperature for Chepseon sub location has been decreasing from 25.9˚C to 25.8˚C from 1982-2011as shown in fig 4.9.

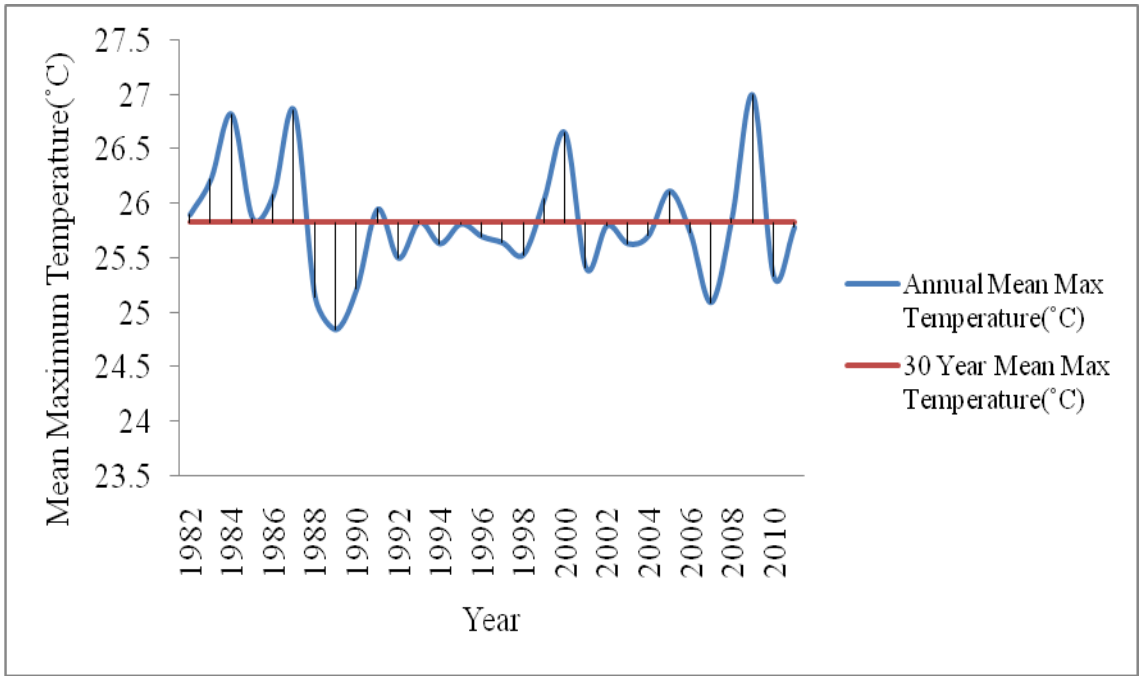

Figure 4.9: Variability of Annual Mean Maximum Temperature from the 30 Year Mean from 1982-2011: Chepseon, Nakuru County. **Source:** KMD, Nakuru Station no: 9036261.

From fig 4.9, the year 2009 had the highest annual mean maximum temperature of 27.0 ˚C. This was the year in which the highest deviation of annual mean maximum temperature from the 30 year mean (25.83˚C) was recorded.The lowest deviation of annual mean maximum temperature of 24.80˚C from the 30 year mean was recorded in the year 1989. This variation of annual mean maximum temperature from the 30 year mean therefore affects the ecosystem stability leading to shortage of resources for both human and wild animals (Lovelock, 2009).This will therefore affect availability of resources for women to carry out their domestic chores leading to their increased vulnerability to climate variability.

4.3.2.2 Mean Monthly Maximum Temperature Trends

According to R.O.K (2010), Kenya has generally experienced increasing temperature trends over many areas. However, the increase in minimum temperature is higher than the increase in maximum temperature. Variability in the mean monthly maximum temperature is shown in Fig 4.10.

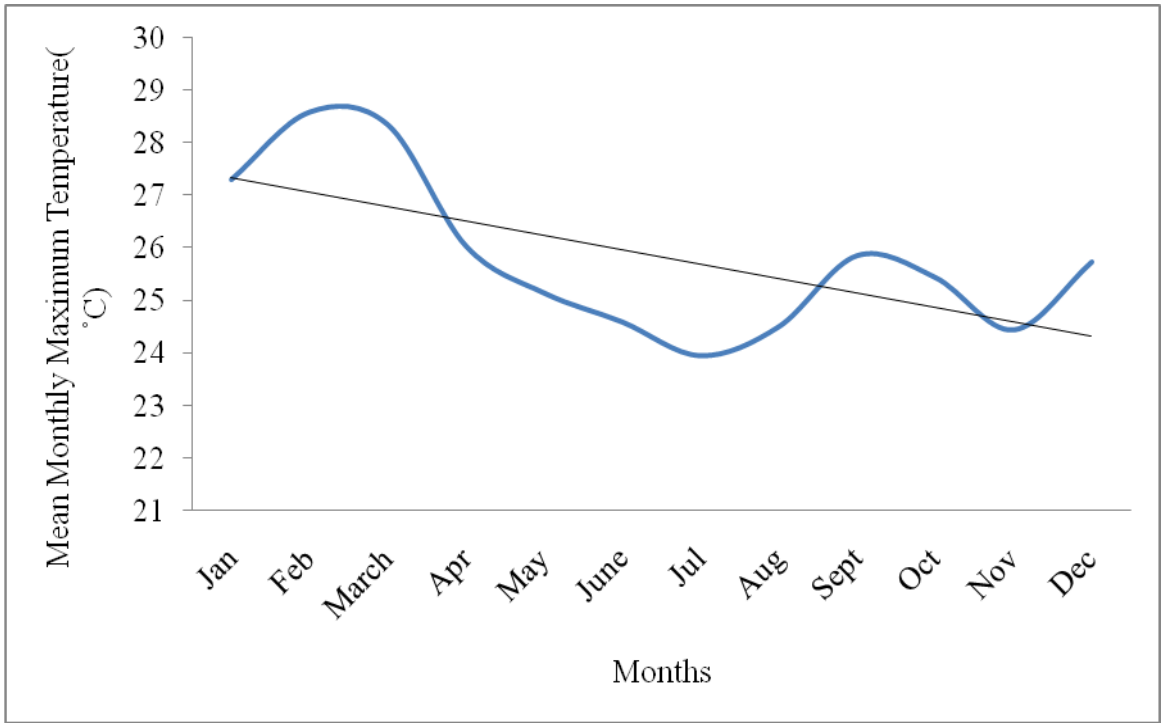

Figure 4.10: Mean Monthly Maximum Temperature (˚C) from 1982-2011: Chepseon, Nakuru County. **Source:** KMD, Nakuru Station no: 9036261.

In general, the mean monthly maximum temperatures were seen to be decreasing over the 30 years from 27.3˚C in the month of January to 25.73˚C in the month of December with the month of February having the highest mean maximum temperature of 28.58˚C, followed by the month of March with an average of 28.34˚C. The month of July recorded the lowest mean monthly maximum temperature of 23.95˚C. There were sharp increases and decreases in temperatures from one month to another in the entire 30 year period of time. This variability in mean monthly maximum temperature affects the availability of natural resources which are vital for women's day to day tasks.

The year 2009 was identified to have had the highest mean monthly maximum temperature extremes in the entire 30 year period of time in four months i.e. June

(26.3˚C), July (26.1˚C), August (27˚C) and November (25.8˚C) as shown in fig 4.11.

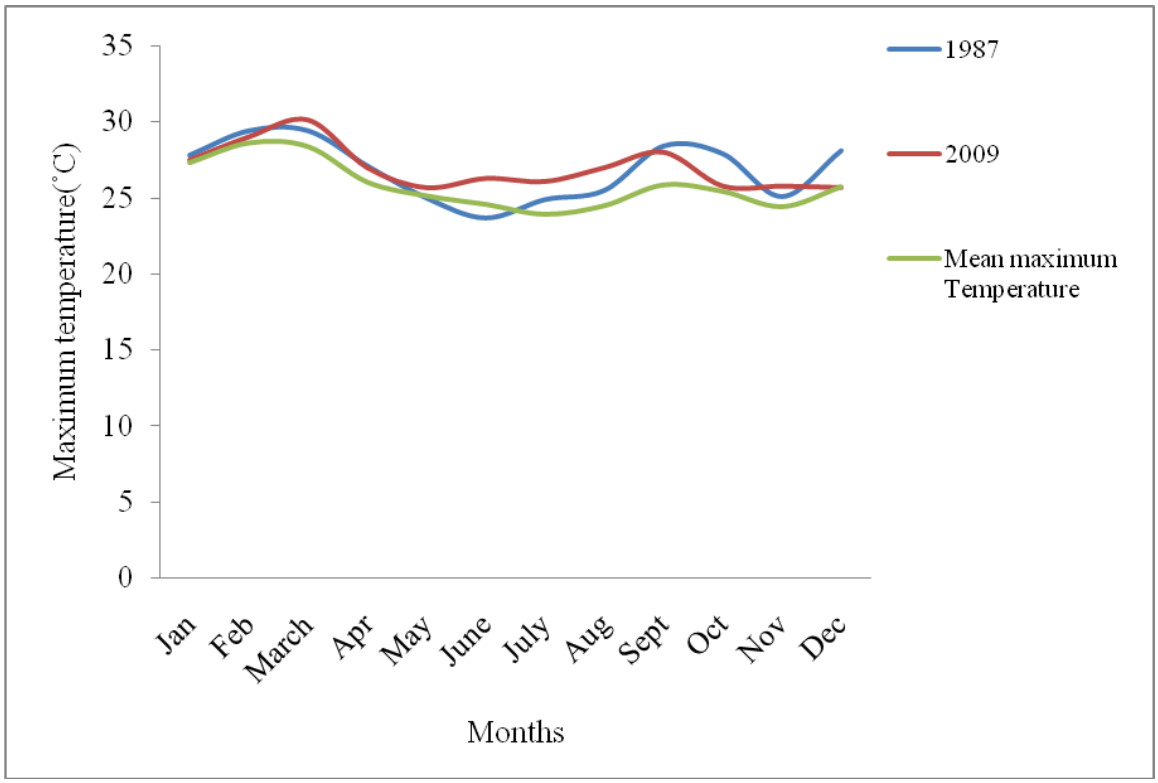

Figure 4.11: Mean Monthly Maximum temperature extremes from 1982-2011: Chepseon, Nakuru County. **Source:** KMD, Nakuru Station no: 9036261.

According to fig 4.11, in the year 1987 the highest mean monthly maximum temperatures were recorded in the months of September (28.4˚C), October (27.9˚C) and December (28.1˚C) in the entire 30 year period of time.

The results from the above analysis shows increased variability in mean monthly maximum temperatures recorded in Chepseon sub location from 1982-2011. This variability in the mean monthly maximum temperatures exposed women's domestic chores to climate variability.

4.3.3 Variability of Annual Mean Minimum Temperature for 30 year period for Chepseon Sub location

Annual mean minimum temperature from 1982-2011 depicted a positive trend (increase) from 10.1˚C to 12.0˚C. This showed that minimum temperatures have been warming with time as shown in fig 4.12.

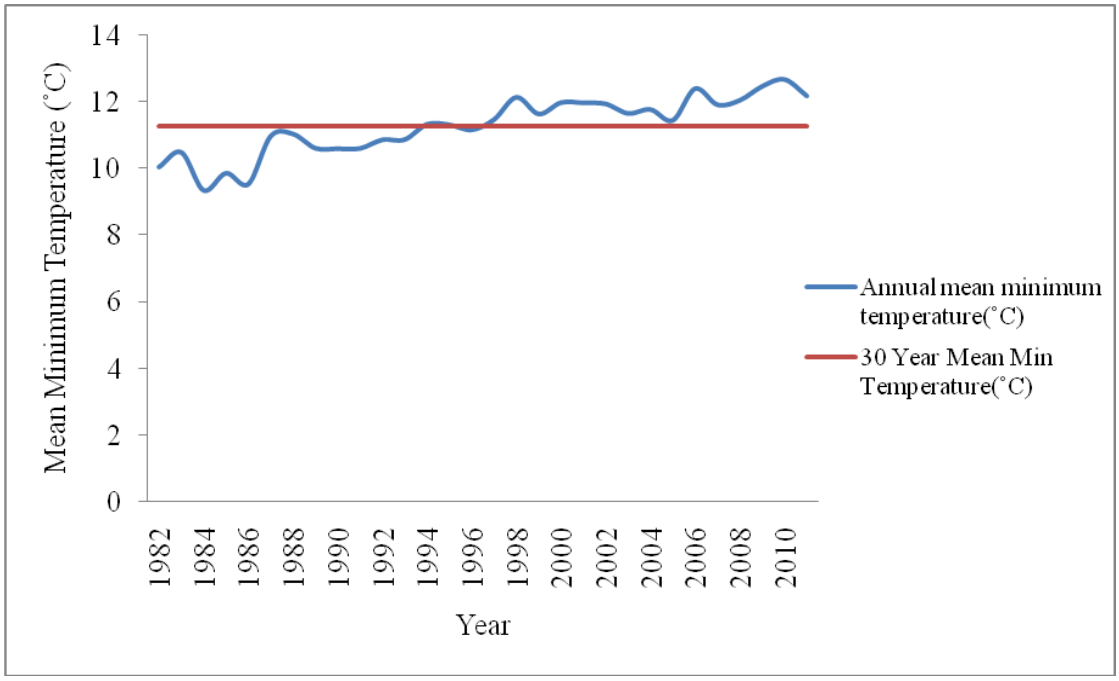

Figure 4.12: Variability of Annual Mean Minimum Temperature from the 30 Year Mean from 1982-2011: Chepseon, Nakuru County. **Source:** KMD, Nakuru Station no: 9036261.

From fig 4.12, the highest annual mean minimum temperature was recorded in the year 2010 of 12.68 (˚C.) This was the year in which there was greater variability of annual mean minimum temperature from the 30 year mean minimum temperature. The lowest annual mean minimum temperature of 9.36˚C was recorded in the year 1984.

4.3.3.1Mean Monthly Minimum Temperature Analysis

According to R.O.K (2010), the trend of minimum temperatures (night time/ early morning temperatures) depicts a general warming through time. This was proven to be true by this study as shown in fig 4.13

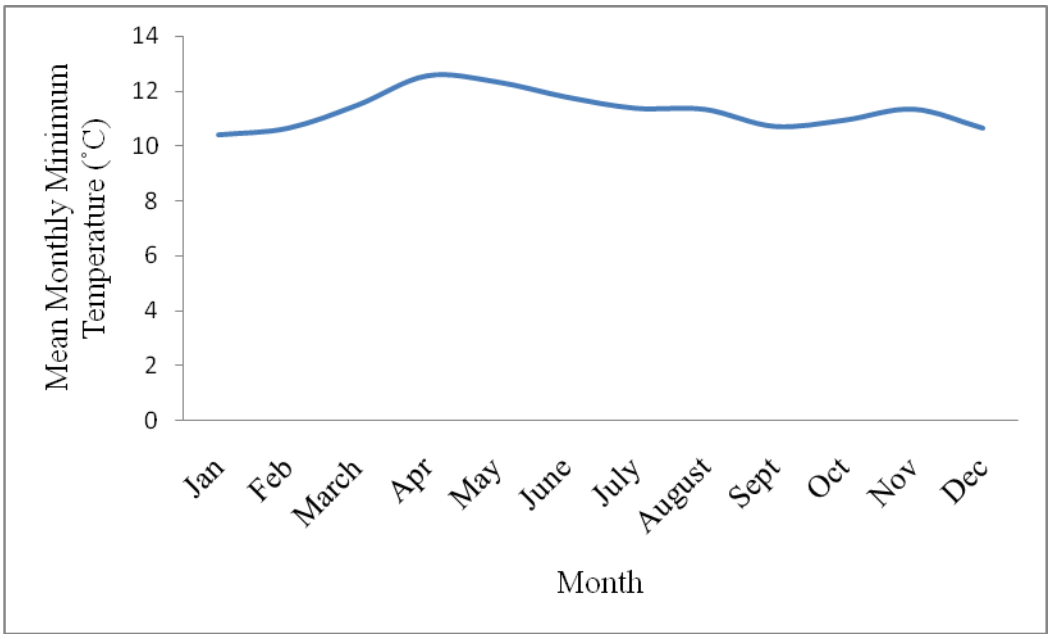

Figure 4.13: Mean monthly minimum temperatures (1982-2011): Chepseon, Nakuru County. **Source:** KMD: Nakuru Station no: 9036261.

In general, the mean monthly minimum temperature has been rising over the entire 30 year period of time from 10.39˚C in the month of January to 10.64˚C in the month of December. However there has been variations in the mean minimum temperature values whereby the mean monthly minimum temperature has been at its highest in the month of April (12.56 ˚C) and at its lowest (10.39˚C) in the month of January. Mean monthly minimum temperatures have been increasing from January (10.39˚C) to April (12.56˚C) and then dropped in May (12.34˚C) until September (10.7˚C) and then gradually rose in October (10.93˚C) to 11.33˚C in November and then dropped in December to 10.64˚C. However, mean minimum temperature extremes were also recorded in the years 1984, 1985 and 2010 as shown in fig 4.14.

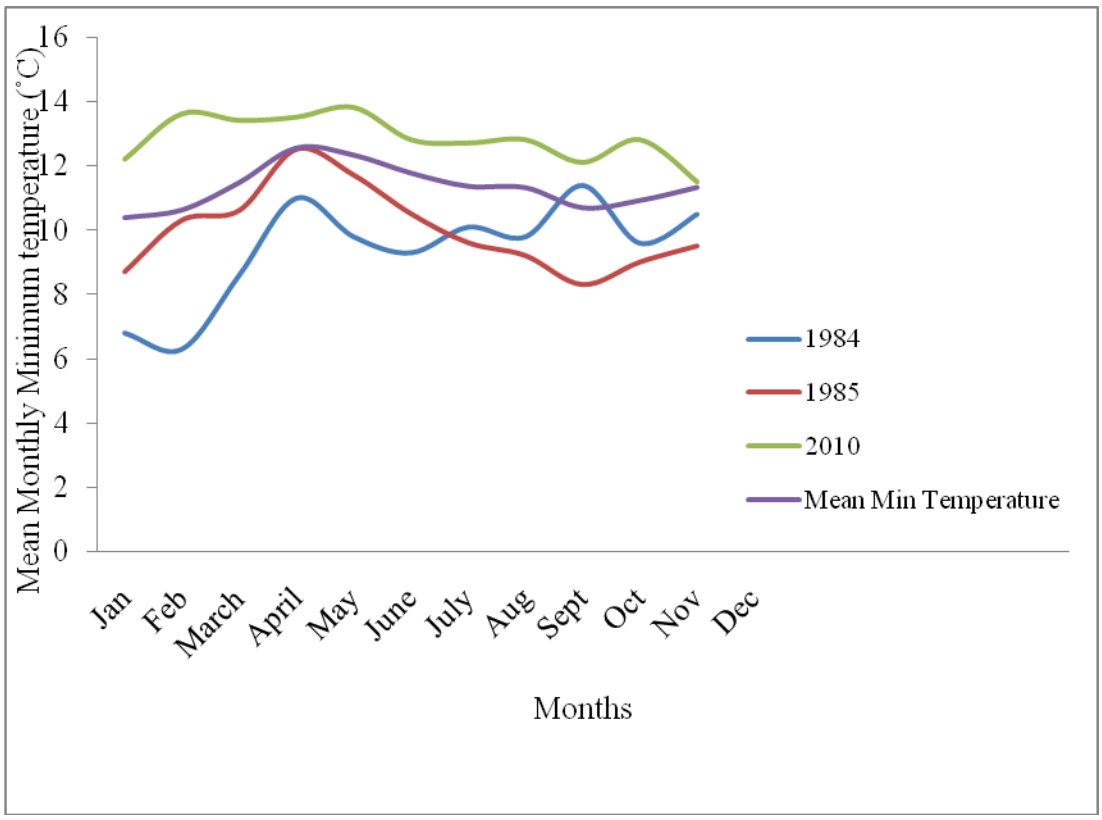

Figure 4.14: Minimum temperature extremes (1982-2011): Chepseon, Nakuru County, **Source:** KMD: Nakuru Station no: 9036261.

From fig 4.14, in 1984 lowest mean minimum temperature extremes were recorded in the months of January (6.8 ˚C), February (6.3˚C), May (9.8˚C) and June (9.3˚C) as compared to the mean in the entire 30 year period of time. They were also recorded in the year 1985 in the months of September (8.3˚C), October (9.0˚C) and December (8.6˚C). Highest mean minimum temperature extremes were recorded in the year 2010 in the months of February (13.6˚C), March (13.4˚C) and August (12.8˚C) in the entire 30 year period of time.

In general, in the entire 30 year period of time, February 1984(6.3˚C) was the month with the lowest mean minimum temperature ever to be recorded and the highest mean minimum temperature of 14.4˚C was recorded in May 1998. Mean Minimum temperatures for Chepseon sub location have been varying in the entire 30 year period of time.

4.4 Relationship between Climate Variability Awareness and the Level of Education

Climate variability awareness is a major factor in determining women's vulnerability to climate variability. Chi-square test was done to determine the relationship between women's level of education and climate variability awareness. Results showed that there was no significant relationship between the level of education and climate variability awareness in Chepseon sub location (χ^2 =2.595, df= 4, 89 and p=0.458). Majority (49%) of those who were aware of variability in climatic conditions had only completed primary school level as shown in fig 4.15.

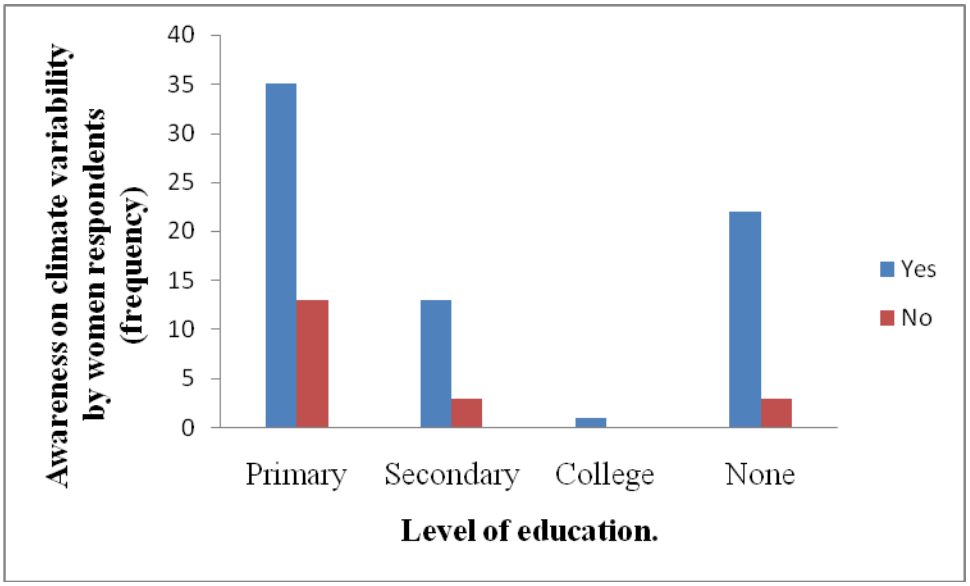

Figure 4.15: Level of education in Chepseon sub location.

The possible explanation for this was that the lesser the level of education the more an individual interacted with environment in trying to meet one's daily needs. This made the less educated women more aware of variability in climatic conditions than those that were educated and were not in close contact with natural resources. According to Ahmed (2008), social responsibilities accorded to women have made them seek help from their girls who end up dropping out of school to help their mothers in carrying out their domestic duties. This increases the number of female student drop outs decreasing the number of educated girls and eventually women who get to formal employment. In developing countries, priority is still placed on boy's education than girl child education.

Girls are the first ones to be pulled out of school when resources run short (Appleton, 1996). According to this study, the higher the level of education, the lesser the women interacted with the environment and therefore the lesser their vulnerability to climate variability. Education opens up opportunities for formal employment among women and therefore becomes financially independent and can easily adapt to variability in climate.

4.5 Variability in Climatic Conditions

Out of the total respondents interviewed, 79% were aware of variability in climatic conditions, while 21% were not aware as shown in fig 4.16

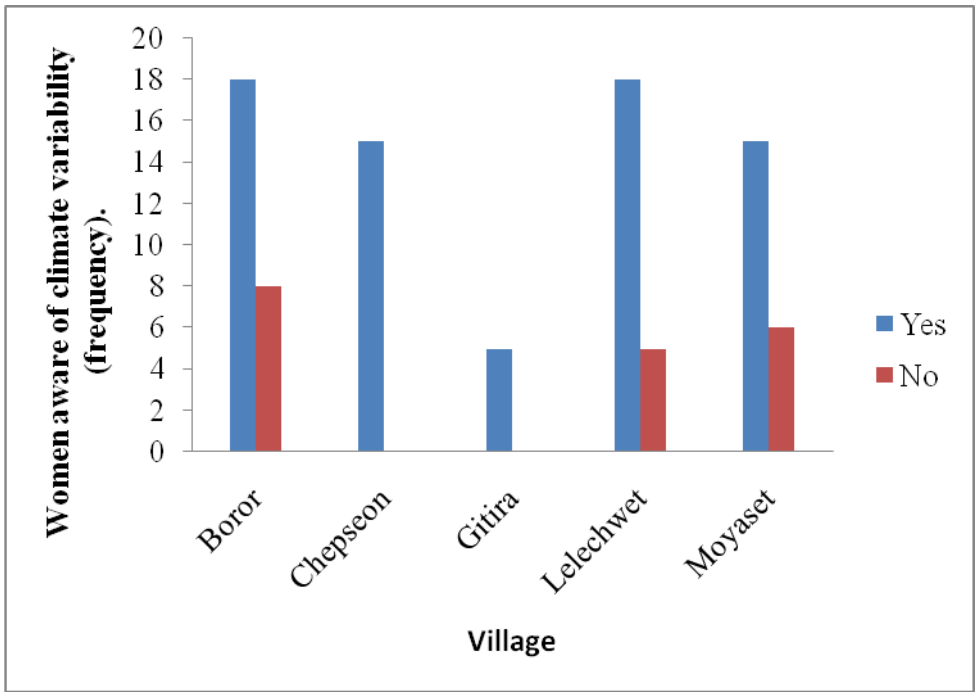

Figure 4.16: Climate variability awareness in Chepseon sub location.

According fig 4.16, awareness on climate variability was highest in both Gitira and Chepseon villages. These were followed by Lelechwet village (78%), Moyaset village (71%) and Boror village (69%). The time period in which climate variability had been observed varied among the respondents as shown in fig 4.17

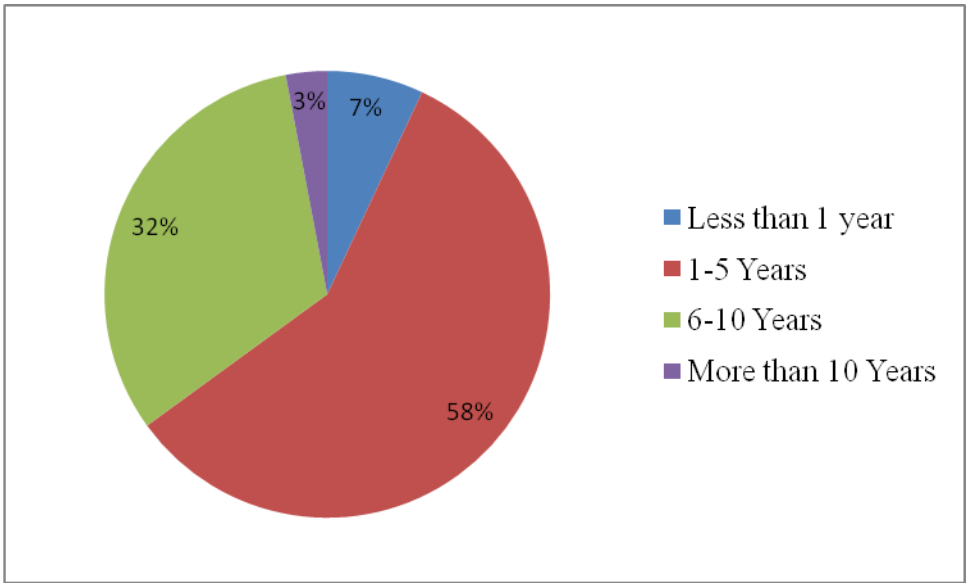

Figure 4.17: Time period in which climate variability had been observed in Chepseon sub location.

From fig 4.17, majority of the respondents had observed variability in climatic conditions between 1-5 years. The possible explanation for this was that they had moved into the sub location recently through marriage and therefore they could only talk of the time they had stayed in the sub location. Those that had observed changes in the climatic conditions for more than 10 years had probably stayed for long in the sub location. Concerning specific variability in climatic conditions identified in the area, majority (59%) of those who had identified variability in climatic conditions had stated increase in temperature. This is in agreement with the results for the minimum temperature analysis whereby in the entire period of 30 years, mean minimum temperature has been recorded to be rising from 10.39 ˚C in January to 10.64 ˚C in December. The remaining 41% had stated erratic rainfall as the most prevalent variability in climate identified in the region. This is also in agreement with the results for precipitation analysis whereby precipitation amounts had been observed to be varying year after year and within the year.

4.6 Changes in the Planting Season

According to Gicheru et al. (2006), precipitation distribution, timing and amounts determine the time period in which farmers plant their crops. Delays in rainfall will lead

to delay in planting of crops by farmers whose agricultural activities are rain-fed. Majority of the respondents (77%) had noticed changes in the planting season while 23% had not noticed any changes in the planting season. Those women who had not noticed changes in the planting season might not have been closely involved in agricultural activities. Out of the 69 respondents who had noticed changes in the planting season, 65 stated that planting season came later. They stated that they used to grow their crops around mid-March when long rain season used to begin but that season had since changed to mid-April or sometimes late April. This is shown in fig 4.18.

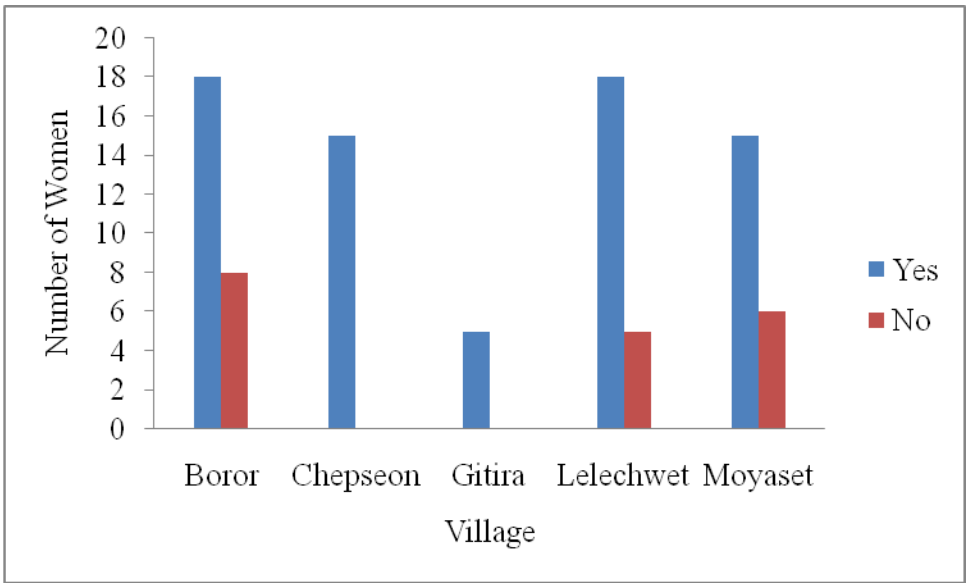

Figure 4.18: Changes in the planting season in Chepseon sub location.

According to fig 4.18, awareness of changes in planting season was highest in Gitira and Chepseon villages then Lelechwet village and lastly Boror and Moyaset villages. Majority of the respondents had noticed changes in the planting season for around 1-5 years as shown in fig 4.19.

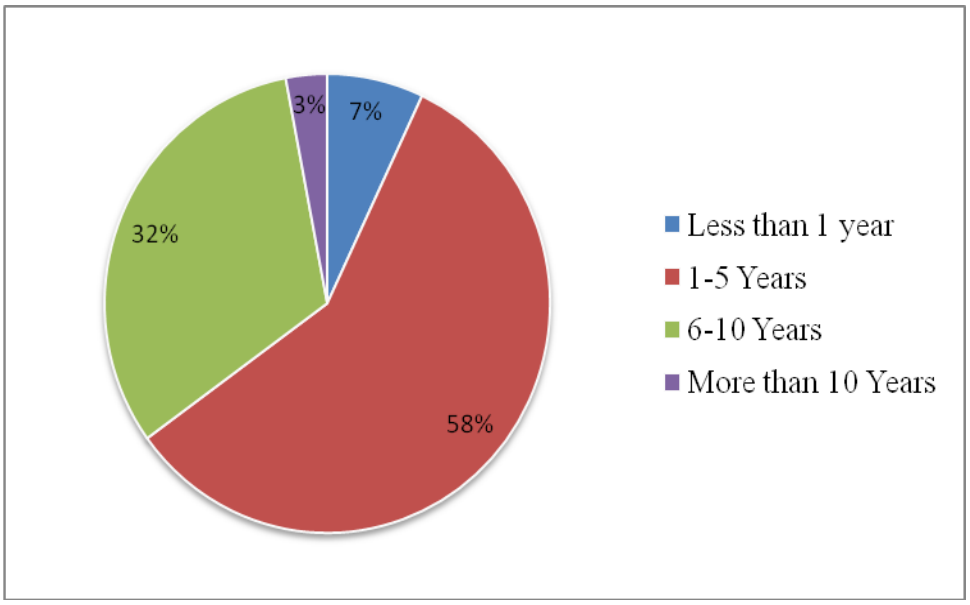

Figure 4.19: Length of time they had noticed changes in planting season in Chepseon sub location.

According to KMD precipitation records, there has been increased variability of rainfall year after year and during the year. The main long rainfall season of March to May has declined with drought evident in between and sometimes it becomes prolonged (R.O.K, 2010a). Agricultural sector will be greatly influenced by climate change leading to shifts in the growing season and reduced crop yield. This will threaten agricultural productivity, hence food security (Nelson et al., 2009; Collier, 2010)

4.7 Source of Climate variability Information

Majority (66%) of women respondents did not have access to climate variability information. However, there were only two sources of climate variability information in Chepseon sub location as shown in table 4.6.

Table 4.6: Sources of climate variability information in Chepseon sub location

Source of climate variability information	Percentage (%)
No access to climate variability information	66
Over the internet	2
Over the media (radio) whenever a calamity occurs	32
Total	**100**

From table 4.6, women in Chepseon sub location could only access climate variability information over the radio when a calamity occurs. None of the respondents had ever attended a seminar or had trained and obtained a certificate in climate variability courses. This means that majority of the respondents did not easily access climate variability information unless there were major events. According to UNDP (2010), women's limited access to crucial information on climate change and their limited means to interpret it is a major contributing factor to their vulnerability to climate variability. Their ability to understand and act on information concerning climate risks and adaptation measures will be greatly affected. This increases women's exposure to climate risks.

4.8 Irrigation of Crops

Majority of the respondents (83%) in the study area did not irrigate their crops while 17% did irrigate their crops in small scale. However, crops that were being irrigated were majorly vegetables and fruits as shown in fig 4.20.

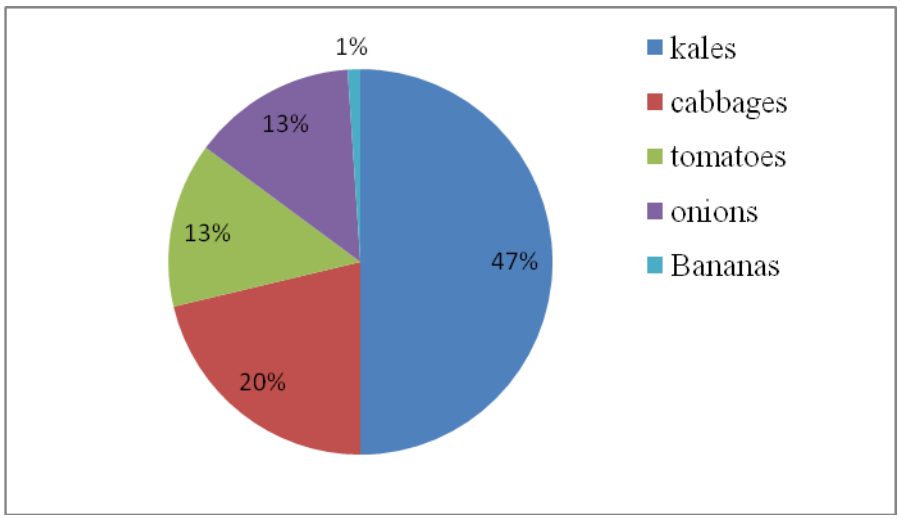

Figure 4.20: Crops irrigated in Chepseon sub location.

Irrigation was done in a very small scale with small overhead sprinklers on an average farm size of less than 1 acre. According to Gicheru *et al.* (2006), increase in temperatures and decrease in rainfall will affect agricultural yields in Kenya because only 2% of the cultivated area is equipped for irrigation. This study revealed that majority of women in the study area did not have irrigational facilities and heavily depended on rains to feed their crops hence increasing their vulnerability to climate variability. This meant that almost all farmers relied on rains to feed their crops. This is shown in plate 4.1.

Plate 4.1: Woman irrigating her tomatoes in Chepseon Sub Location

According to the farmer, irrigation of her tomatoes was only possible when water pressure was high. This meant that if water pressure was reduced (which sometimes did happen for more than 2 weeks), her crops would only depend on rains of which if it failed, the crops would wither and if water was not supplied, they would eventually die.

4.9 Access to Credit Facilities by Women in Chepseon Sub location

Micro finances support adoption of technology packages such as irrigational facilities and water harvesting technology through the use of tanks (Deressa et al., 2008). These are important in adapting to climate variability. Chi-square test was done to establish the relationship between income per month earned by women in Chepseon sub location and their access to credit facilities. Results showed that, there was no significant relationship between income earned per month by women in Chepseon sub location and their access to credit facilities (χ^2 =2.057 p=0.725, df = 4, 62). This was because there were various sources of credit facilities of which not all of them required some security in form of income earned per month for women to access as shown in table 4.7.

Table 4.7: Access to credit facilities by women in Chepseon sub location

Source of Credit Facilities	Frequency	Percentage (%)
Bank	5	10
Borrowing from friends	9	18
Borrowing from family members	11	22
Borrowing from women groups	25	50
Total	**50**	**100**

From table 4.7, only 56% of the respondents were in a position to access credit facilities. Majority of them (25) were members of various women groups and could access their credit facilities from these groups. These women groups included: Silver Ladies women group, Rongai Social and Economic Women Organization (ROSEWO) and Kas ak Icham women group.

The main objectives of these organizations were to

a. enable women to be financially self-reliant through giving out loans with reduced interest rates and

b. build at least one water tank per month (capacity 10,000 liters) for every member.

However, there were major challenges that were faced by members of these groups in accessing credit facilities. These were: Lack of assets to act as security for loan repayment and some members had no regular source of income which made it hard for them when it came to repayment of the loan.

One of the major challenges that were faced by these women groups was an increase in the number of loan defaulters. The main reason for this was due to

lack of assets that could be sold out in a case where one failed to repay back the loan.

It was also noted that those women groups communicated climate variability issues to their members and an effort had been made by having them build water tanks that would help in storing water for use during dry spell.

The number of women borrowing loans from banks was low due to requirements that one should meet before accessing a bank loan. Some of the requirements included: a bank account of which most women did no have, salary slip and land title deeds of which they could only have access to and did not have control over it. They could therefore not use land as a form of security to have a bank loan. This indicated that the percentage of women who owned assets like land was small because land is one of the major resources that provide financial security when one borrows a bank loan. Lack of access to microfinance by women increased their vulnerability to climate variability. They lacked capacity to adapt to varying climatic conditions.

4.10 Sources of Water

According to Hannan and Anderson (2001), water is an important resource when it comes to women domestic chores. It is therefore very important to provide water to women in order to perform their duties without having to strain. There were four sources of water for women in Chepseon sub location as shown in fig 4.21.

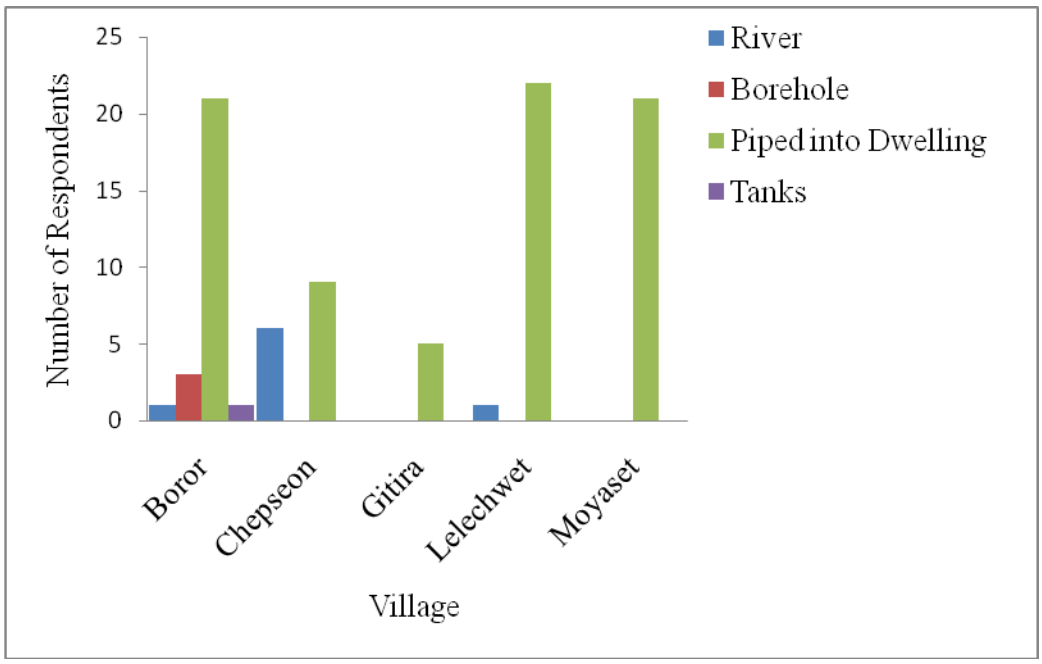

Figure 4.21: Main Source of Water in Chepseon sub location**.**

According to fig 4.21, all the 5 villages of the sub location had piped water. Most women in the study area did not have to walk over long distance in search of water because it was already in their dwelling units. This saved them time to undertake other domestic duties. However, not all women in the sub location had access to piped water because their taps were disconnected by Rongai Rural Water Supply (RRWS) due to unsettled water bills. In addition to having piped water, some women in Boror village had boreholes and tanks which collected water during rainy seasons. This was an important adaptation measure in case where piped water failed to get to their homes due to low pressure and reduced precipitation.

Majority of the population under study (51%) stated that climate variability had impacted on their main source of water. This led to reduced volumes of water that came from the taps and they sometimes had to go for some days (around two days) without water in their taps due to water rationing. Those who got their water from the boreholes had noted changes in the water table while those who relied on roof top harvesting had their tanks empty during the dry seasons.

4.11 Main Source of Energy for Cooking

Women in African communities have been assigned a role of cooking food for their families (Sands, 2005). This requires supply of energy for cooking. There were three sources of energy used by women in Chepseon sub location as shown it the fig 4.22.

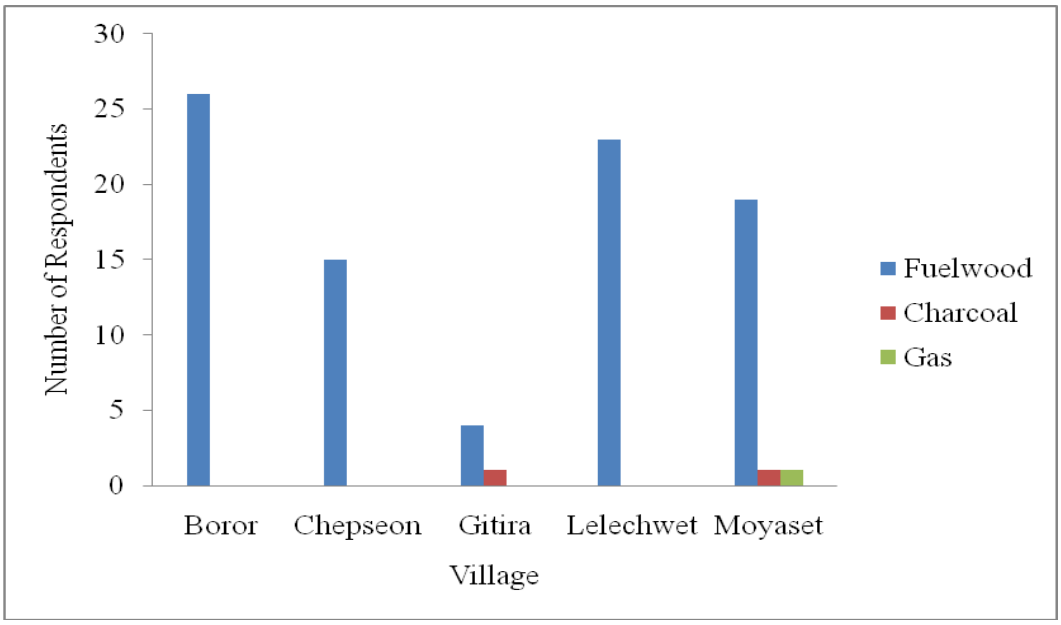

Figure 4.22: Source of energy for cooking in Chepseon sub location.

According to fig 4.22, majority of respondents in the study area (97%) used fuel wood as the main source of energy for their cooking. This is in agreement with a study done by Ashington *et al.* (2007) which shows that majority of Kenyans living in rural areas use traditional biomass (mainly wood fuel) as source of energy for their cooking.

4.11.1 Source of Fuel Wood for Cooking

Women in Chepseon sub location had four sources of fuel wood for cooking as shown in fig 4.23

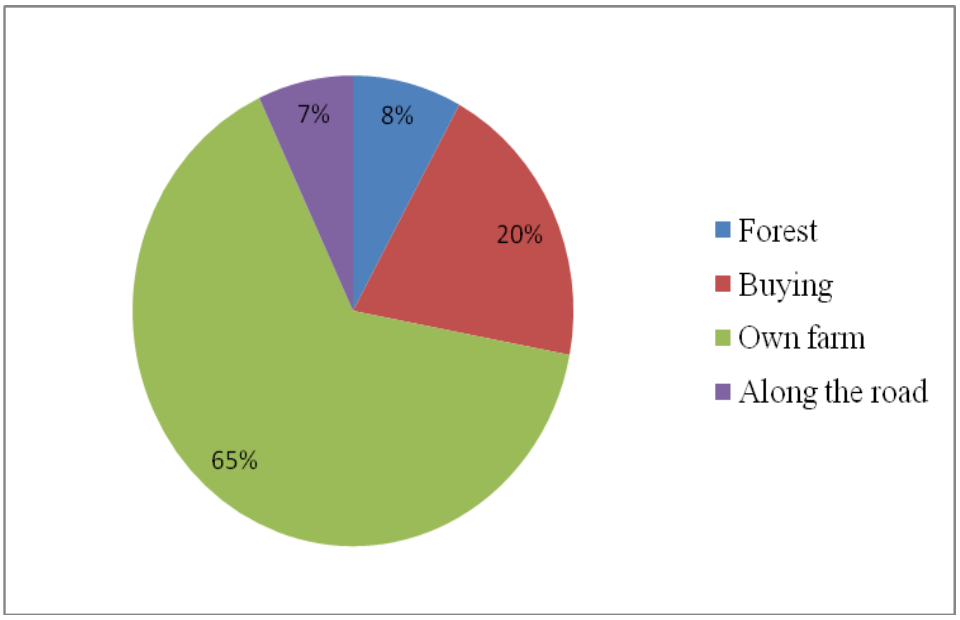

Figure 4.23: Source of fuel wood for cooking in Chepseon sub location.

Majority of women in Chepseon sub location had planted trees in their farms for fuel wood provision. The reasoning they gave to this was that, the forest they used to depend upon for fuel wood provision was being depleted by charcoal burners and the impacts of climate variability. Regarding fuel wood availability, 89% of those women who used fuel wood stated that climate variability had impacted on fuel wood availability that lead to reduced tree cover in the region while 11% had not seen any changes on fuel wood availability. It is estimated that in Kenya, wood provides about 73% of the total energy consumption mainly in form of charcoal for heating and cooking in urban areas and as fuel wood in rural areas (Bess, 1989; R.O.K, 1997). Due to cost implication associated with charcoal and biogas, majority of women in the study area had no other options than fuel wood. Fuel wood is the most affordable source of energy for rural women and has been persistently the commonest energy option for these people. Due to fuel wood scarcity in the neighboring forest (Delloraine) that resulted form reduced tree cover, many women in the study area had opted planting trees in their own farms as a response to the unavailability of fuel wood. In 1980, it was estimated that, the nationwide consumption of fuel wood was at 21 million tones with a per capita consumption of more than one tone in a year. The replacement rate within the same period of time was only

60% which indicated that the available fuel wood was diminishing on a very fast rate (Karanja, 2003). However, use of fuel wood as source of energy for cooking is associated with respiratory disease infections among users due to excessive products of incomplete combustion and emission of smoke in poorly ventilated houses common in rural areas (Ashington *et al.,* 2007). Most of the women who used fuel wood as source of energy for cooking had large stock of fuel wood in readiness for use as shown in plate 4.2 below

Plate 4.2: Fuel wood stored in readiness for use in heating and cooking in a rural home in Chepseon Sub location

Women in the area had cut down trees in large numbers in order to get fuel wood. This had reduced the amount of tree cover in the region exposing women to the dangerous impacts of climate variability. Their use of trees was also unsustainable because they were cutting them down instead of pruning them. Only 1% of the population under study used biogas as a source of energy for cooking as shown in plate 4.3

Plate 4.3: Biogas plant in a rural home in Chepseon Sub location

Energy plays a significant role in the lives of rural communities. Compared to fuel wood, biogas is a cheap household energy source because it is renewable, simple to generate and convenient to use. It is also environmental friendly because it does not release GHGs to the atmosphere.

4.12 Challenges Faced in Accessing Medical Facilities

The most prevalent challenge faced by women in Chepseon sub location was insufficient medical facilities followed by the long distance covered in accessing medical facilities as shown in fig 4.24.

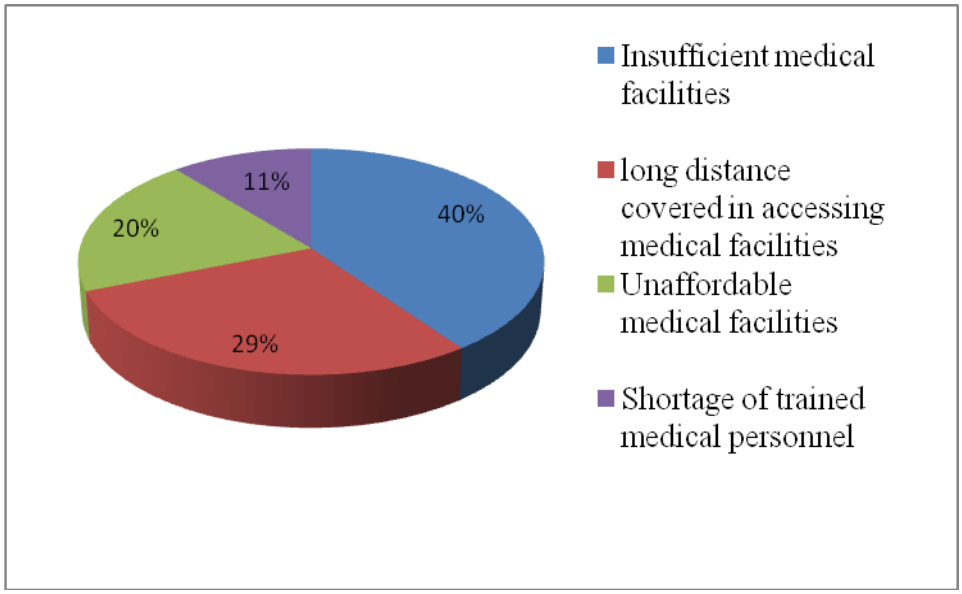

Figure 4.24: Challenges faced in accessing medical facilities in Chepseon sub location.

It was found out that there was only one dispensary in the study area known as Lelechwet dispensary serving the entire Sub location. There were about 6 private clinics located in Salgaa shopping center. Most women in Chepseon Sub location opted going for medical services offered at the local dispensary than clinics in Salgaa due to high cost of their services although there was shortage of trained medical personnel. There were only two nurses and one pharmacist in the dispensary. Access to medical facilities enables the provision of preventive treatments for diseases such as malaria and dysentery associated with climate change (Deressa, 2008). However, there were challenges that were specific to each village as a result of their geographical location as shown in fig 4.25.

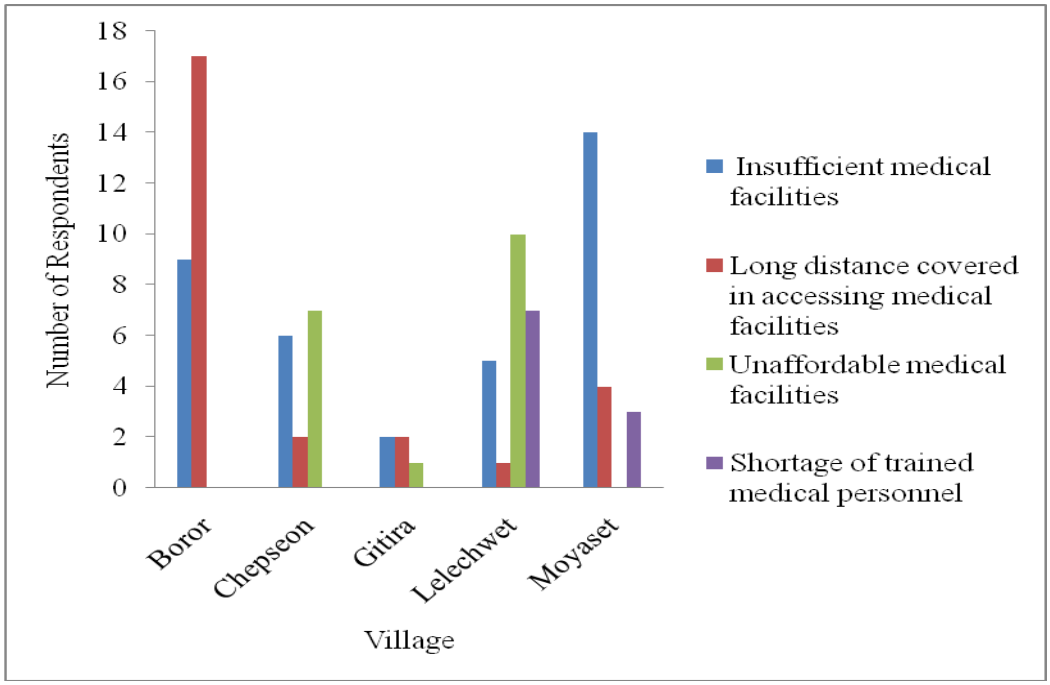

Figure 4.25: Challenges faced by women in accessing medical facilities in Chepseon sub location.

Fig 4.25 shows the specific challenges faced by women in accessing medical facilities. The major challenge that was faced by respondents from Boror village was the long distance covered in accessing medical facilities. They had to travel over 4 km in search of medical services in Lelechwet dispensary. In Chepseon village, the major challenge was unaffordable medical facilities offered in private clinics in Salgaa shopping Center. While in Gitira and Moyaset villages, their major challenge was insufficient medical facilities. Access to medical services and their affordability is very important to women especially in an event of varying climatic conditions. Climate change has led to unequal distribution of food which has increased the rate of malnourishment, increased spread of water borne diseases such as cholera and typhoid due to flooding and increased spread of malaria (Bartlett, 2008). Limited access to medical care has therefore exposed women to risks associated with climate change.

4.13 Access to Subsidized Farm Inputs

Most of the respondents were subsistence farmers and therefore needed to be provided with farm inputs at affordable prices as an effective way to promote their growth. Majority of the respondents did not get any of the farm inputs at a subsidized price as shown in fig 4.26.

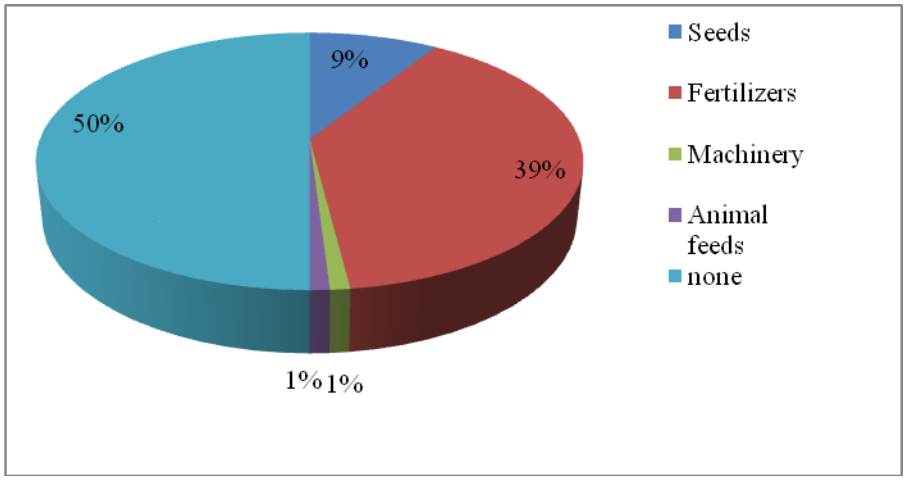

Figure 4.26: Access to subsidized farm inputs in Chepseon sub location.

The results in fig 4.26 were a clear indication that not all farmers were in a position to get subsidized farm inputs. This might have resulted from the fact that, one could only access subsidized fertilizers and seeds from regional centers in Nakuru which was roughly 50 km away from the sub location. Owing to transportation costs many subsistence farmers (women) could not go for the fertilizers and seeds. The mode of issuing was also a major contributing factor to unequal distribution of fertilizers and seeds. This was due to the fact that some farmer could be allowed to purchase more than 10 bags of fertilizers and many packets of maize seeds which they would go and sell to farmers on the ground at a higher price.

4.14 Road Conditions in Chepseon Sub location

Well developed infrastructure play a role in adapting to climate change by facilitating access to resources e.g. all weather roads facilitate the distribution of necessary inputs to farmers and increased access to market in a timely manner (Deressa, 2008).

Majority (44%) of the population under study were dissatisfied with road transport network to market their farm produce as shown in fig 4.27.

Figure 4.27: Level of satisfaction with road conditions by women in Chepseon Sub location.

Majority of those who were extremely satisfied with road transport network were from Gitira village which was located along Nakuru- Eldoret highway and could easily get to Salgaa market because the road was in a very good condition. Majority of those dissatisfied with road transport network came from Boror village which was located far away form the highway and was supplied with poor network of rough roads. Those rough roads were in very poor condition to an extent that when it rained farmers could not gain access to the market and farm machinery such as tractors could not get into their farms. For the residents of Moyaset village, majority were dissatisfied with road transport network except for the regions that boarded Chepseon village where although there were network of rough roads, they were in a better condition compared to road networks in Moyaset as shown in fig 4.28.

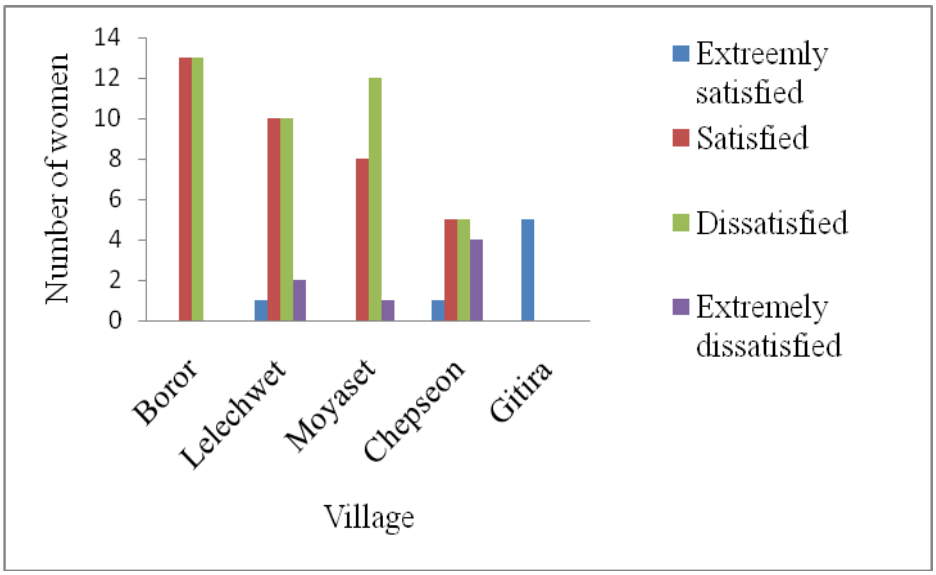

Figure 4.28: Level of satisfaction with the road conditions in Chepseon sub location.

4.15 Access to Downscaled Weather Information in Chepseon Sub location

Majority of the respondents (71%) accessed downscaled weather information over the media (radio) while 39% did not have access as shown in fig 4.29.

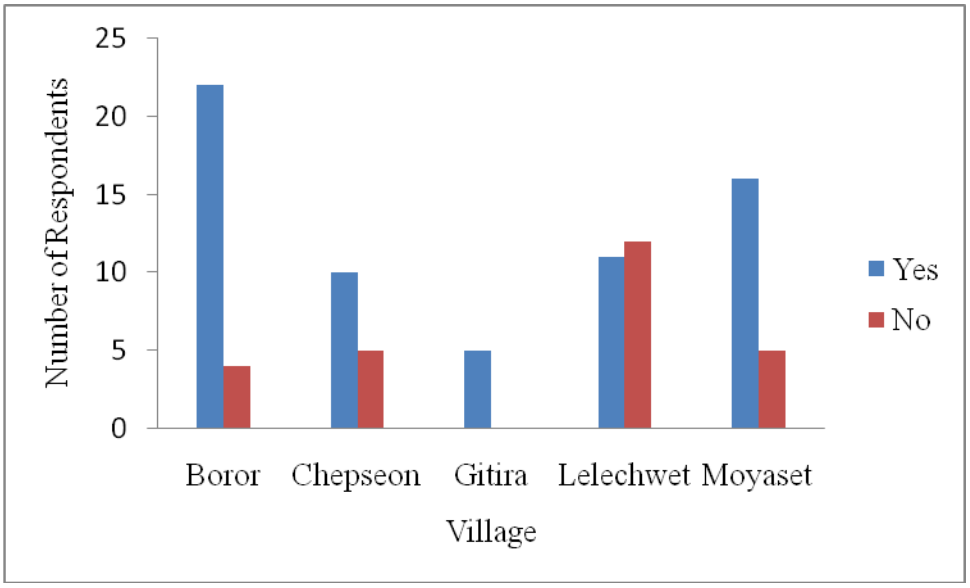

Figure 4.29: Access to downscaled weather information in Chepseon Sub Location.

Fig 4.29 shows that access to downscaled weather information was highest in Gitira village. However, all the respondents who had access to downscaled weather information got them from the radio. Access to downscaled weather information is important in alerting women on various steps they should take in order to adjust to any changes associated to weather conditions. Downscaled weather information should be made available to women in a timely manner to avoid risks that might be caused by varying climatic conditions. In this way women will not be exposed to impacts of climate variability.

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 SUMMARY

This study was aimed at assessing women domestic chores and vulnerability to climate variability in Chepseon sub location. In this regard three study objectives were set out. This chapter summarizes the findings of the study along the study objectives. Recommendations are made and area for further research is suggested.

5.2 CONCLUSION

5.2.1 Climate variability has been experienced in Chepseon sub location from 1982-2011

The two parameters of climate that were under consideration were temperature and precipitation. Results showed that total precipitation amounts over the 30 year period of time varied. There was a general increase in precipitation from1982 to 2011 whereby rainfall had increased over the years from 1071.5mm to 1106.5 mm. However, the 5 year moving averages showed increased variability in the amount of precipitation received. There were also drastic changes in rainfall within the 30 year period, with the lowest amount of annual precipitation (573.2mm) recorded in the year 1991and the highest amount of total annual precipitation (1434.9mm) recorded in the year 2010.This irregular and unpredictable amounts of precipitation had an effect on availability of natural resources for women to accomplish their domestic chores.

The annual mean maximum temperature depicted a negative trend from 25.9˚C in the year 1982 to 25.8˚C in the year 2011. This however, was a very small decrease in the annual mean maximum temperature. At the same time, the mean monthly maximum temperature depicted a negative trend (decrease) over the 30 year period of time (1982-2011). It decreased from 27.3˚C in the month of January to 25.73˚C in the month of December. This variability in the mean monthly maximum temperatures also affected natural resources that were important for women to accomplish their domestic chores.

The annual mean minimum temperature trend depicted a positive trend (increase) over the 30 year period of time (1982-2011). It rose from 10.03˚C in the year 1982 to 12.0˚C

in the year 2011. However there were variations in the annual mean minimum temperature values from one year to another. The mean monthly minimum temperature also showed an increase from 10.39˚C in the month of January to 10.64˚C in the month of December. This had an effect on natural resources that women depended upon to accomplish their domestic chores. Climate variability was therefore experienced in Chepseon sub location from the year 1982-2011.

5.2.2 There was no significant relationship between women's level of education and climate variability awareness in Chepseon sub location

The results from the study indicated that there was no significant relationship between women's level of education and climate variability awareness in Chepseon sub location (χ^2 =2.595, df= 4, 89 and p=0.458). Majority (49%) of those who were aware of variability in climate had only completed primary school level, 31% who never went to school, 18% who completed secondary school and finally 2% who had completed college level. The possible explanation for this was that lesser the level of education the more an individual interacted with the environment in trying to meet one's daily needs making them particularly aware of changes that take place within that environment. Those who were highly educated got some formal employment and therefore depended less on the environment to meet their daily needs hence were not aware of changes that occurred within that environment. It is therefore important to educate girls to higher levels of education in order to minimize their dependence on natural resources to meet their needs. This is the basis for reducing women's vulnerability to climate variability.

5.2.3 Women domestic chores and adaptive strategies that they had in place to cushion them from harmful effects of climate variability

According to this study, women domestic chores were classified into 6 groups. These were: cooking food, farm work, collecting fuel wood, fetching water, milking cows and herding of cows, goats and sheep. However, cooking dominated morning hours, farm work dominated mid day and fuel wood collection dominated afternoon hours.

Adaptive strategies were subdivided into various categories because various indicators were chosen to reflect women's adaptive capacity:

i. **Level of education:** The number of women who completed primary education in Chepseon sub location was higher (53%) than those who proceeded to the next level. This limits them from gaining access to formal employment and to crucial climate variability information that would help them in adapting to climate variability.

ii. **Irrigational facilities:** Majority of the respondents did not irrigate their crops (83%). For those who did so, it was in a very small scale and crops irrigated were vegetables and fruits only. This showed that they were ill equipped in coping with climate variability.

iii. **Availability of infrastructure:** The only village that was extremely satisfied with road network was Gitira village which was located next to Nakuru-Eldoret Highway. The other villages (apart from some parts of Chepseon village) had rough roads that were not passable in rainy days. This posed a challenge in accessing market for agricultural inputs and marketing of their farms produce.

iv. **Changing climatic conditions:** the two parameters that were used to determine climate variability in Chepseon sub location were rainfall and temperature. These parameters showed increased variability year after another and within the year as discussed in 5.2.1 (the first objective above).

v. **Access to credit facilities:** Majority (56%) were able to access credit facilities form various lending institutions. This was important in enabling women to invest in additional income generating activities.

Women in Chepseon sub location were therefore not well prepared to cope with climate variability. There is need therefore to build their capacity to adjust to changes in climatic conditions. This can be done through the following ways:

i. Educating them on need to harvest water during rainy seasons for use during drought seasons and installation of irrigational facilities.

ii. Improving infrastructure to enable women to gain access to market in a timely manner and get access to subsidized farm inputs.

iii. Creating awareness on variability in climatic conditions.

5.3 RECCOMENDATIONS

The following recommendations are made in order to improve women's resilience to climate variability in Chepseon sub location.

5.3.1 Recommendations on adaptation and coping strategies to be employed by women in adjusting to climate variability in Chepseon sub location

The following are some of the adaptation and coping strategies that should be employed by women in Chepseon sub location in adjusting to climate variability:

a) Water harvesting and storage in times of heavy rains in order to use during dry spells.
b) Installing of irrigation facilities to irrigate crops during dry weather conditions and to avoid depending on rains entirely to feed their crops.
c) Planting of drought tolerant, early maturing and disease resistant crop varieties
d) Diversification of income sources.
e) Crop diversification (changing the crop mix) to counter the impact of short variation in weather conditions.
f) Use of alternative sources of energy e.g. biogas, solar energy for heating and cooking.

5.3.2 Recommendations for improving women's resilience to climate variability in Chepseon sub location

i. Provision of subsidized farm inputs that can reach all subsistence farmers regardless of their location.
ii. Increased access to micro- finances with reduced interest rates.
iii. Access to government medical facilities with reduced costs which should also be well equipped with medicine and medical personnel.
iv. Awareness on the causes and consequences of climate variability should be made in order to sensitize women on its' dangers and the possible ways of adapting and mitigating it.
v. Training programs should be offered on the use of new technologies e.g. energy-efficient cooking stoves and ovens and renewable energy systems.

vi. Weather- indexed crop insurance should be made available to women subsistence farmers. This insures farmers against losses in crop yields resulting from weather-related stresses. As climate impacts become increasingly critical to agricultural production in Kenya, insurance is likely to play a great role in absorbing shocks and spreading risk.

5.3.3 Recommendation for further research

i. More research into the gender specific health impacts of climate change should be done on children and women to help build women's resilience to climate change.

REFERENCES

African Ministerial Conference on the Environment (AMCEN) (2011). *Addressing Climate Change Challenges in Africa: A Practical Guide Towards Sustainable Development*. Retrieved on 5th March 2013 from www.unep.org/roa/amcen/docs/publications/guidebook-Climate change .pdf.

Ahmed, W. (2008). *Gender, Climate Change and Human Security: Lessons from Bangladesh, Ghana and Senegal.* New York: The Women's Environment and Development Organization.

Anthony, K. (2011). *Modern Rongai Constituency Strategic Plan*. Nairobi: Big Books Limited.

Appleton, S. (1996). *Women-headed Households and Household Welfare: An Empirical Deconstruction for Uganda:* World Development, 24. Pg 1811-1827

Araujo, A., Quesada-Aguilar, A., Aguilar, L.& Pearl,R. (2007). *Gender Equality and Adaptation.* USA: Women's Environment& Development Organization (WEDO) and The International Union for Conservation of Nature(IUCN). Retrieved from www.genderandenvironment.org/admin/admin_biblioteca/documentos/Factsheet%20Adaptation.pdf on 27th September 2012.

Ashington, N.,Bell, O.,& Floice., A. (2007). *Promoting Biogas Systems in Kenya: A Feasibility Study.* Biogas For Better Lives , 3.

Bartlett, S (2008)."*Climate Change and Urban Children: Impacts and Implication for Adaptations in low and Middle income countries.* International Institute for Environment and Development (IIED). UK: IIED.

Bess, M.(1989). *Kenya Charcoal Survey.* Final report and annexes, prepared for the Long Range Planning Unit, Ministry of Planning and National Development and Carleton University: Nairobi.

Boserup, E. (1989). *Women's Role in Economic Development.* London: Earth Scan Publications.

Brody, A., Dometriades, J. & Esplen, E. (2008).*Gender and climate change: Mapping the linkages.* Brighton: Institute of Development Studies, University of Sussex.

Canadell,J.G., Raupach, M.R., Field, C.B.,Buitenhuis, E.T., Ciais, P., Conway, T.J., Gillett, N. P. Houghton , R.A., Le Quere,C. & Marland, G. (2007). *Contributions to Accelerating Atmospheric* CO_2 *Growth for Economic*

Activity, Carbon Intensity and Efficiency of Natural Sinks. Proceedings of the National Academy of Science 104(47), 18866-18870.

Care International (2009). *Mainstreaming Climate Change Adaptation.* In J. H. Yen, *A Practitioners Handbook* (p. 13). Vietnam: Care International.

Climate Change Convention (CCC) (2009). *Climate Change, Gender and Vulnerable Groups in Bangladesh.* Climate Change Cell, DoE, MoEF; Component 4b,CDMP, MoFDM.2009, Dhaka Bangladesh.

Collier, W. (2010). *Colonial maize and climate: limits for agricultural development for adaptation in rift valley*. tropical resources: the bulletin of the yale tropical resources institute, 11 - 15.

Confalonieri, U., Menne, B., Akhtar, R., Ebi, K,L., Hauengue, M., Kovats, R.S., Revich, B. &Woodward, A. (2009): *Climate Change Impacts, Adaptation and Vulnerability.* Contribution of Working Group II to the Fourth Assessment Report of the Intergovermental Panel on Climate Change. Cambridge University Press. Cambridge:UK.

Denton, F. (2002). *"Climate Change, Vulnerability, Impacts and Adaptation: Why does Gender Matter?"* Gender and Development, 10.Pg 10-20.

Deressa, T. R. (2008). *Measuring Ethiopian Farmers' Vulnerability to Climate Change Across Regional States.* Washington,DC USA: International Food Policy Research Istitute.

Fatma, D. (2002). *"Climate Change Vulnerability,Impacts and Adaptation: Why does Gender Matter?".* Gender and Development , 10-20.

Food and Agricultural Organization (FAO) (2008). "Climate Change, Bioenergy and Food Security" Option for the high level conference World Food Security. The challenges of climate change and bioenergy , June 3-5 Rome.

Food and Agricultural Organization (FAO) (2010). *Climate change implications for food security and natural resource management in Africa.* Twenty sixth regional Conference for Africa, Angola, 3-7th May 2010.

Food and Agricultural Organization (FAO) (2011).*"Water Resources and Irrigation in Africa."* Rome: FAO. Retrieved on 7th March 2013 from http:/www.fao.org/NR?water/aquastat/watresafrica/index7.stn

Forster, P., Ramaswamy, V., P, Artaxo, T, Berntsen., R. Betts., D.W, Fahey., J, Haywood., J, Lean., D.C. Lowe., G, Myher., J, Nganga., R. Prinn., G, Raga., M, Schulz & R, Van Dorland (2007): *Changes in Atmospheric Constituents and in Radiative Forcing.* In: climate Change 2007: The Physical Science Basis. Contribution of Working Group 1 to the Fourth Assessment Report of the intergovernmental Panel on climate Change

[Solomon, S., D. Qin., M. Manning., Z, Chen., M, Marquis., K, Averyt ., M, Tigor & H, Miller (eds.)]. Cambridge: Cambridge University Press.

Gicheru,E.,Gachene,C.K.,P.G.&Claessen, L.(2006). *Anticipated Climate Change and Impact on Kenyan Agriculture.* Nairobi: UNEP COP 2006 p.23

Hannan, C. and Anderson, I. (2001).*Gender perspectives on water supply and sanitation: towards a sustainable livelihoods and ecosystem-based approach to sanitation.* Summary version of a paper prepared for the 97th Annual Meeting of the Association of American Geographers. New York.

Herrero, M., Ringler, C., Van de Steeg, J., Thornton, P., Zhu, T., Bryan, E., Omolo, A., Koo, J. & Notenbaer, A. (2010). *Climate Variability and Climate Change and their Impacts on Kenya's agricultural sector*. Nairobi, Kenya. ILRI

Indenje, M., Semazzi, F and Ogallo, L (2000). *ENSO Signals in East African Rainfall and their Prediction Potentials.* International Journal of Climatology 20:19-46

Intergovernmental Pannel on Climate Change (IPCC) (2007*). Climate Change 2007:The Physical Science Basis.* Contribution of Working Group 1 to the Fourth Assessment Report of the IPCC. Geneva: IPCC.

Intergovernmental Pannel on Climate Change (IPCC) (2001). *Climate Change 2001: Impacts,adaptation and vulnerability.*Contribution of Working Group II to the Third Assessment Report of the Intergovermental Panel on Climate Change. Cambridge: Cambridge University press.

International Union for Conservation of Nature (IUCN) (2007). *Gender and Climate Change.* Retrieved from www.un.org/womenwatch/downloads/Resource_Guide_English_Final_pdf on 10th March 2013.

Justina. D., and Esplen. E. (2008). *The Gender Dimensions of Poverty and Climate Change Adaptation.* Institute of Development Studies.

Karanja, F., Ogallo, L.J., Mutua, F.M., Olundhe, C. &Kisia, S. (2002). *Kenya Country Case Study: Impacts and Responses to the 1997-98 El Nino Events*. Retrieved on 8th March 2013 from http://www.ccb.ucar.edu/un/Kenay.html

Karanja, G. A. (2003). *Biogas production*. Nairobi: KARI headquarters.

Katharine, V. and Lucy, W. (2010). *Gender,Climate Change and Community- Based Adaptation* . New York: UNDP.

Kenya Red Cross (2009). *Drought Appeal 2009-Alleviating Human Suffering*. Kenya Red Cross Society (KRCS), District Steering Groups (DSGs), Kenya Food

Security Steering Group (KFSSG). Retrieved on 8th March, 2013 from http://www.kenyaredcross.org

Khamis, M. and Saiful. M (2006). *"Tsunami Response and Women."* Malaysia: Universiti Kebangscan Malaysia.

King, D. A. (2004). *Climate Change Science: Adapt, Mitigate or Ignore?* Science, 303,176-177.

Kowero, G., Chidumayo, E., Okali, D. & Larwanou, M. (eds) (2011). *Climate change and African Forest and Wildlife resources.* African Forest Forum, Nairobi, Kenya.

Leggett, J. A. (2007). *Climate Change:Science and Policy Implications*. Congressional Research Service. Retrieved on 5th March 2013 from www.crs.gov

Lovelock, J. (2009). *The Vanishing Face of Gaia.* New York: Basic Books.

McFerson, H. M (2008). *"Poverty Among Women in Sub Saharan Africa: A Review of Selected Issues."* International Women's Studies, 11. Pgs 50-72.

McMullen, C.P and Jabbour J (eds) (2009). *Climate Change Science Compedium*. Geneva: UN Environmental Programme, pg 72

Mitchell,T., Tanner,T. &Lussier,K. (2007).*"We Know What We Need!"* South Asian Women Speak Out on Climate Change Adaptation, Action Aid International and Institute of Development Studies. Downloaded on 27th September 2012 form www.ids.ac.uk/UserFiles/Files/poverty_team/ActionAid__IDS_Report_We_know_what_we_need_South_Asian_women_speak_out_on_climate_change_adaptation.pdf

Mugenda, O. and Mugenda, A. (2003). *Research Methods:Quantitative and Qualitative Approaches* . Nairobi, Kenya: ACTS Press.

Nelson, G. C., Rosegrant, M.W., Koo,J. &Robertson,R.(2009).*Climate Change: Impact on Agriculture and Costs of Adaptation.* Washington: International Food Policy Research Institute (IFPRI)

Nhemachena, C., and Hassan, R. (2007). *Micro- level Analysis of Farmers' Adaptation to Climate Change in South Africa.* Washington DC: International Food Research Institute.

Osbahr, H. &Viner, D. (2006). *Linking Climate Change Adaptation and Disaster Risk Management for Sustainable Poverty Reduction*. Kenya Country Study. A study carried out for the Vulnerability and Adaptation Resource Group (VARG) with support from the European Commission.

Otiende, B. (2009). *The Economic Impacts of Climate Change in Kenya: Riparian Flood Impacts and Cost of Adaptation.* Kenya National Advisory Committee for the DFID funded study on the Economic impacts of Climate Change in Kenya.

Parry, L., Rosenzweig, C. & Livermore, M. (2005). *'Climate Change, Global Food Supply and Risk of Hunger '.* Philosophical Transactions of the Royal Society.

Pearce, D., Cline, W., Achanta, A., Fankhauser, S., Pachauri, R., Tol, R., Vellinga, P., (1996). *The Social Costs of Climate Change: Green House Gas Damage and Benefits of Control.* Cambridge University Press. Cambridge.

Republic of Kenya (ROK) (1997). *National Development Plan 1997-2001*.Nairobi: Government Printers.

Republic of Kenya (ROK) (2005). *Millennium Development Goals in Kenya: Needs and Costs.* Nairobi: Government Printers.

Republic of Kenya (ROK) (2010a). *National Climate Change Response Strategy Executive Brief.* Nairobi: Government Printers.

Republic of Kenya (ROK) (2010b). *National Climate Change Response Strategy*. Nairobi: Government Printers.

Ryan,L., Mihoko,K.& Pia, T. (2011). *Africa Adaptation Programme Experiences: Gender And Climate Change: Advancing Development Through an Intergrated Gender Perspective.* New York:UNDP.

Sands, R. (2005). *Forestry in a Global Context*. Wallingford, UK: CABI.

Thornton, P.K., Jones, P.G., Alagarswamy, G., Andresen, J. & Herrero, M. (2009):*Adapting to Climate Change : Agricultural Systems and Household Impacts in East Africa.*Elservier Ltd. doi:10.106/j.agsy.2009.09.003.

Thuiller, W. (2007). *"Climate Change and the Ecologists"*, in Nature 448/2:550-552.

Thuiller, W., Lavorel,S., Araujo, M.,Sykes, M. &Prentice, I.(2005).*Climate Change Treats to Plant Diversity in Europe.* Proceedings of the National Academy of Sciences 102/23:8245-8250.

United Nations Commission for Africa (UNECA)(2010). *Economic Report on Africa, 2010*.Retrived from www.uneca.org on 1st March 2013.

United Nations Development Fund for Women (UNIFEM) and United Nations Division for the Advancement of Women (DAW) (2001). *The Situation of Rural Women Within the Context of Globalization.* Mongolia: Ulaanbaatar.

United Nations Development Program (UNDP) (2007):*Human Development Report 2007/2008:Fighting climate change :Human solidarity in a divided world.* New York: UNDP.

United Nations Development Program (UNDP) (2009*). Resource Guide on Gender and Climate change.* New York: UNDP. Retrieved on 23rd September 2011 from content.undp.org/go/cms-service/download/asset/?asset_id=1854911

United Nations Development Program (UNDP) (2010). *Gender, Climate Change and Community-Based Adaptation: A Guidebook for Designing and Implementing Gender-Sensitive Community Based Adaptation Programs and Projects.* New York: UNDP.

United Nations Development Program (UNDP) (2010). *'What will it take to achieve the Millennium Development Goals?'.* New York: UNDP.

United Nations Environment Program (UNEP) / Republic of Kenya (ROK) (2005): *Climate Change Vulnerability in Kenya: Response and Strategies*. Nairobi:UNEP.

United Nations Environment Program (UNEP)/Republic of Kenya (RoK) (2000). *Devastating Drought in Kenya. Environmental Impacts and Responses*. UNEP/GOK. Nairobi. Kenya.

United Nations Environmental Program (UNEP) (2006). *Crop Production in a Changing Climate.* Geo year book. Nairobi: UNEP.

Wakhungu, J.W. and Elvin. N. (2010). *Oyola and Wakesi in Kenya: locals adapting to effects of climate change.* Nairobi: African center for technology.

World Bank (2010). *Development and Climate Change* World development report. Washington, DC: World Bank

APPENDICES

Appendix I. Establishing the linkages between MDGs, climate change and gender.

Millennium Development Goals	**Threats due to climate change**	**Gender implications**
1: Eradicate extreme poverty and hunger	. Leads to reduction in agricultural production and hence increased food insecurity . Less access to safe water	. loss of plants species used by women to ensure food security of their families . Increase in women workload due to decline in availability of water
2: Achieve universal primary education	. Increases the workload needed for agricultural production and other subsistence activities .Environmental changes are likely to cause migration	. Girls and women are responsible for the collection of water and fuel wood. With climate change, they invest a lot of time in these activities limiting their time to attend school. . Migration of populations due to extreme climate change , could interrupt and limit the opportunities for education
3: To promote gender equality and empower women	. Climate change will increase cultural barriers and conflicts	. Threatens women's health, safety, inequitable access to education, resources and employment opportunities.
4: Reduce child mortality	.Climate change will increase the spread of water borne diseases . Increases the rates of child malnutrition	. Increase in women's workload due to their role as primary caregivers in their families.
5: Improve maternal health	. Increase the prevalence of some water and vector borne diseases	.As water collectors, women are susceptible to water borne diseases
6: Combat HIV/AIDS, malaria and other diseases	.Increase in temperatures(heat waves) and increased air pollution (respiratory diseases)	. Women and children are fourteen times more likely to die than men during a disaster. High mortality rates of mothers during disasters results in an

		increase in the number of orphans and early marriages for girls causing them to drop out of school; trafficking and prostitution which in turn increases exposure to HIV/AIDS. . In developing countries, the poorer households affected by HIV/AIDS have less resources to adapt to impacts of climate change.
7: Ensure environmental sustainability	.Extinction of species, change in species and disruption of symbiotic relationships. .Changes in the quality and the quantity of natural resources could reduce the productivity of ecosystems.	. Women are less likely to be able to cope with climate change impacts, without secure access to and control over natural resources. . Decrease in forest resources used by women. . Permanent temperature change will reduce agro-biodiversity and traditional medicine options.
8: Create a global development partnership	. There is need to increase financial resources for adaptation and mitigation initiatives.	. The response to climate change to support national adaptation and mitigation efforts must include principles of gender equality.

Source: IUCN (2007).

Appendix II: Women domestic chores and vulnerability to climate variability questionnaire

Form serial no……

Date: ……

This study is carried out to determine women domestic chores and vulnerability to climate variability which will later be used to recommend suitable adaptation and coping strategies that will help to build their resilience to climate variability. It is therefore conducted purely for academic purposes and any information provided will be treated with privacy and confidentiality. Please put a tick in the box next to the response where applicable.

SECTION A.

1. Age (years)_____
2. Name of your village _____
3. a. Did you go to school?

   [ ] Yes [ ] No

   b. If yes, what is the highest education level completed?

   [ ] Primary

   [ ] Secondary

   [ ] College

   [ ] University

4. What is your professional training?

   [ ] Teacher

   [ ] Nurse

   [ ] Doctor

   [ ] Police woman

[ ] None

Other (specify) _____

5. Type of farmland

[ ] public/Government

[ ] community (managed by local council)

[ ] private

[ ] leasehold

6. Size of farm (acres) _____

7. Family size_____ Number of children_____

8. a .Which is your main source of income?

[ ] Self-employment

[ ] Earnings from employment (employed)

[ ] Retirement pension

[ ] Interests from savings and investment

[ ] No regular source of income

b. How much do you earn per month?

[ ] Less than Ksh 1000.00

[ ] Ksh 1,000.00-5,000.00

[ ] Ksh 6,000.00-10,000.00

[ ] Ksh 11,000.00- 15,000.00

[ ] Over Ksh 16,000.00

9. Using the table provided below, insert the activity that you carry out during the different times of the day.

Time of the day.	**Activity.**
Morning.	-
Mid day.	-
Afternoon.	-

SECTION B.

10. a. Are you aware of any variability in climatic conditions?

[ ] Yes [ ] No

b. If yes, how long have you noticed the changes?

[ ] less than 1 year

[ ] 1-5 years

[ ] 6-10 years

[ ] more than 10 years

c. In a scale of 1-4 given below, indicate by filling in the box the code number of the most prevalent variability in climate that has been experienced in this region [ ]

1-increase in temperatures

2- Erratic rainfall

3-increase in sea level

4- Melting of ice caps

11. a. Have you noticed any change in the planting season?

[ ] Yes [ ] No

b. If yes, how: [ ] earlier [ ] later

c. How long have you noticed the change?

[ ] less than 1 year

[ ] 1-5 years

[ ] 6-10 years

[ ] More than 10 years

12. Which is your main source of climate variability information? Indicate your main source of climate variability information by filling in the box the code number of the source selected i.e. 1 to 5 [ ]

1- I do not have any access to climate variability information

2- I access climate variability information over the internet

3- I obtain climate variability information on the media whenever a calamity happens or during the major events

4- I trained and obtained a certificate in climate variability courses

5- I attended a climate variability seminar

SECTION C

13. a. Do you irrigate your crops?

[ ] Yes [ ] No

b. If yes, what is the size of farmland under irrigation?

[ ] less than 1 acre

[ ] 1-5 acres

[ ] 6-10 acres

[ ] 11-15 acres

[ ] Over 15 acres

c. Which crops do you irrigate?

_____

14. a. Are you able to access credit?

[ ] Yes[ ] No

b. If yes, where:

[ ] Bank

[ ] Borrowing from friends

[ ] Borrowing from family members

[ ] Borrowing from women groups

Other (specify) _____

15. a. Which is your main source of water?

[ ] River [ ] Well [ ] Borehole [ ] Piped into dwelling

[ ] Tanks-roof top harvesting [ ] Water vendor

b. Has climate variability impacted on the source of water?

[ ] Yes [ ] No

16. a. Which main source of energy do you use in cooking?

[ ] Fuel wood [ ] Charcoal

[ ] Gas [ ] Paraffin (kerosene)

b. If fuel wood, where do you get it from?

[ ] Forest [ ] Buying

[ ] Own farm [ ] Other (specify)_____

c. Has fuel wood availability changed for the last 5 years?

[ ] Yes [ ] No

17. What major challenge do you face in accessing medical facilities in this region?

[ ] insufficient medical facilities

[ ] long distance covered in accessing medical facilities

[ ] unaffordable medical facilities

[ ] shortage of trained medical personnel

18. a. Which of the following farm inputs do you get at a subsidized price?

[ ] Seeds [ ] Fertilizers

[ ] Machinery [ ] Animal feeds

19. Are you satisfied with road transport network to market your farm produce? Indicate the level of satisfaction by putting a tick in the box next to the response

[ ] Extremely satisfied [ ] Satisfied

[ ] Dissatisfied [ ] Extremely dissatisfied

20. a. Do you have access to downscaled weather information?

[ ] Yes [ ] No

b. If yes, where do you gain access to this information?

[ ] over the internet

[ ] over the media

[ ] in seminars and workshops

[ ] women's economic and social groups

[ ] in barazas

[ ] at home (from family members)

Thank You.

Appendix III: Access to savings and credit facilities by women in Chepseon sub location questionnaire

Form no…….

Date: ……

Key informants: Representative from Social and Economic organizations in Chepseon Sub location.

This research is conducted purely for academic purposes and any information provided will be treated with privacy and confidentiality.

1. What is the name of your organization?

   …….

2. When was it established?

   …….

3. What are the objectives of your organization?

   ……

   ……

4. What are the requirements for membership in your organization?

   .....

   .....

5. How many women from Chepseon Sub Location are members of this organization?

   ……

6. What services do you offer to your members?

   ……

   ……

   ……

   ……

7. What challenges are faced by members of your organization in accessing credit facilities?

……

……

……

……

……

8. Do you offer any training to your members?

[ ] Yes [ ] No

9. a. Do you communicate any climate variability issues to your members?

[ ] Yes [ ] No

Thank You.

Appendix IV: Questionnaire for Nakuru District Environmental Officer

Form Serial No: ……

Date: ……

This research is conducted purely for academic purposes and any information provided will be treated with privacy and confidentiality.

1. a. Is there any variability in climatic conditions experienced in this region?

[ ] Yes [ ] No.

b. If yes, how long have you noticed the variability in climatic conditions?

[ ] less than 1 year

[ ] 1-5 years

[ ] 6-10 years

[ ] more than 10 years

c. In a scale of 1-4 given below, indicate by filling in the box the code number of the most prevalent variability in climate that has been experienced in this region [ ]

1-increase in temperatures

2- Erratic rainfall

3-increase in sea level

4- Melting of ice caps

d. What effects does it have on natural resources?

……

2. a. What natural resources do women depend on in this region for their daily activities?

……

……

b. Do they use natural resources sustainably?

[ ] Yes [ ] No.

c. If yes, how?

……

……

3. a. Do you offer any environmental awareness programs or campaign in this region?

[ ] Yes [ ] No.

b. If yes, on what environmental issues?

……

……

c. Which organizations are actively involved in environmental awareness creation in this region?

……

……

4. What sources of energy do you recommend to be used by women in an effort to safeguard the environment?

……

Thank You.

Appendix V: Access to Agricultural Inputs by Subsistence Female Farmers.

To be administered to Nakuru District Agricultural Officer.

Form No: ……

Date: …….

This research is conducted purely for academic purposes and any information provided will be treated with privacy and confidentiality.

1a. Is there any variability in climate experienced in this region?

[ ] Yes

[ ] No.

b. If yes, how long have you noticed the variability in climatic conditions?

[ ] less than 1 year

[ ] 1-5 years

[ ] 6-10 years

[ ] more than 10 years

c. In a scale of 1-4 given below, indicate by filling in the box the code number of the most prevalent variability in climate that has been experienced in this region [ ]

1-increase in temperatures

2- Erratic rainfall

3-increase in sea level

4- Melting of ice caps

d. What effects does it have on agricultural production?

……

……

……

2. Which of the following farm inputs do you offer at a subsidized price?

[ ] Seeds [ ] Fertilizers [ ] Machinery

[ ] Animal feeds Other (specify) _____

3a. Do you offer farmers agricultural extension services?

[ ] Yes [ ] No

b. Which extension services do you offer to the farmers?

……

……

……

4.a. Are fast maturing and disease resistant varieties of seeds available to farmers?

[ ] Yes [ ] No

b. If yes, which are they?

……

Thank You.