CLIMATE VARIABILITY AND RESPONSE STRATEGIES AMONG THE GADAMOJI AGRO-PASTORALISTS OF MARSABIT COUNTY, KENYA

BY

HALKANO JILLO BORU (B.Env.Sci)

N50/CE/10680/07

DEPARTMENT OF ENVIRONMENTAL EDUCATION

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

JUNE 2013

DECLARATION

Declaration by Candidate

This research project report is my original work and has not been submitted to any other examination body. All the sources of materials used for this work has duly been acknowledged.

Halkano Jillo Boru (B.Env.Sci)

N50/CE/10680/07

Signature……Date…5/12/2013

Declaration by Supervisors

This research report has been submitted with our approval as University Supervisors

Dr. James Koske

Signature……Date……

Department of Environmental Education

Dr. Daniel G. Manguriu

Signature……Date…6/12/2013……

Department of Environmental Education

DEDICATION

This work is dedicated to my beloved Late dad, **Jillo Boru**, who suddenly passed on while I was in a lecture hall been prepared for this work. He's a treasure I'll miss forever!

ACKNOWLEDGEMENTS

First and foremost, I thank the almighty God in whose grace, guidance and mercy everything has been made possible!

My earnest gratitude goes to my supervisors, Dr. James Koske and Dr. Daniel Manguriu, for their constructive criticism, advice and meticulous guide throughout the course of the study.

I would also like to express my deepest gratitude to my loving mother and brothers for their prayers and indefatigable faith in me. Special thanks too to my friends Dabo G., Boru Jillo and Hassan Mulata for their assistance and endless moral support in my entire study period.

Finally, my sincere appreciation goes to the very cooperative people of Gadamoji division who volunteered to share their experiences and knowledge during my fieldwork. Their immense knowledge on climate change and struggles to innovatively adapt their livelihoods is amazing and humbling.

ABSTRACT

Climate is perceived to be changing thus calling for livelihood adaptation strategies and integrated understanding at local level to guide in developing climate-resilient livelihoods. The objective of this study was to assess perception of climate variability, impacts and household response strategies among agro-pastoralist in Gadamoji division, Saku District of Marsabit County in the period1998-2012. Out of 1335 households, one hundred and thirty three (133) were randomly selected from four sub-locations that make up the division. Data was gathered using structured questionnaires and interviews administered to households as well as three Focused Group Discussion. The study data was statistically analyzed and results discussed and presented in graphs and tables. The results revealed that local people have noticed rainfall and temperature variability. The perceived changes include changes in various aspects of rainfall and increase in temperature. Indeed, they were able to link their livelihoods albeit subjectively to climate variability with79.3% of the respondents acknowledging that the changes have adversely and significantly impacted on their households' sources of income. Main impacts identified include repeated crop failure, reduced and/or loss of livestock holdings, increased households' poverty and rampant water shortage. Besides, most respondents anticipate that these effects will worsen in future with majority attributing the variability to destruction of natural forest. The study also found that most households have adjusted their crops farming and animal husbandry practices in response to climate variability effects over the last 15 years preceding the study. Direct nature-based livelihoods (livestock tending and crop cultivation) were reduced and alternative non-farm activities (casual and wage employment, sale of wood products and trade) increased. In fact, only 24 % and 2.1 % of the respondents consider livestock rearing and crop farming respectively as their main sources of income. The study, however, revealed that though climate was a key factor, other social factors also accelerated the changes in livelihoods strategies in the division. The study further revealed a number of innovative response strategies pursued by households. These are: diversification to off-farm incomes, switch to drought-resistant livestock types, saving of assets for lean seasons as well as kitchen gardening practices. These measures are however found inadequate and are manly self-adaptation practices pursued by households in a disorganized ways. In exploring desired livelihoods options to future climate effects, the study found that most households prefer to invest in small scale irrigation, engage in non-farm income activities, diversify herd composition, practice agro-forestry, invest in livestock insurance as well as undertake water harvesting. Further, the study revealed that both current and future strategies are challenged by poverty and lack of capital, climate uncertainty and unreliable climate information and inadequate knowledge on other livelihoods options. These constraints can be alleviated through awareness on climate variability, support to existing livelihoods strategies and assets, improve access to market information, enhance access to credit services and adoption of conflict management strategies. Otherwise, achieving livelihoods resilience and food security in the division will remain delusion for years to come.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

LIST OF ABBREVIATIONS AND ACRONYMS

ASALs: Arid and Semi Arid Lands

FGDs: Focused Group Discussions

IPCC: Intergovernmental Panel on Climate Change

NCRS: National Climate Change Response Strategy

SPSS: Statistical Package for Social Science

UNFCCC: United Nations Framework Convention on Climate Change

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

Scientific evidence increasingly suggests that climate is becoming more variable with significant impacts on small-scale farmers (IPCC, 2007). Of all the continents in the world, Africa particularly sub-Saharan Africa is the most vulnerable to climate change and variability. This is because majority of their rural population relies on rain-fed agriculture as a source of food production and livelihood foundation (Cooper et al, 2008; IPCC, 2007).

In Kenya, economic and livelihood systems depend on agriculture. Rural households in particular rely heavily on rain-fed agriculture thus changes in climatic conditions have far reaching implications on the households' social and economic wellbeing (Deressa et al, 2008). In the past two decades, for instance, successive crop failure, water shortage and loss of livestock attributed to extreme weather events are increasingly blamed for deteriorating livelihoods among most rural areas in the country (Mutimba et al, 2010; Obando et al, 2010).

Climate variability was projected to increase in Southern Africa countries including Kenya in the coming decades (Lioubimtseva & Henebry, 2009). Given that the process of climate change cannot be stopped quickly, it's crucial to understand in view of responses adopted by people whose livelihoods depend on it.

Despite its multiple effects, awareness on climate change particularly among the rural folk in Kenya, however, remains low (Mutimba et al, 2010). An opinion poll carried out between 2007 and 2008; for instance, found that over 44% of Kenyans majority of whom are rural people depend on climate sensitive economic sectors have no knowledge of climate change or opportunities in it. A better understanding of farmers' perceptions along with adopted adaptation measures was paramount to inform future actions (Mutimba et al, 2010; Bryan et al, 2011).

Although knowledge on climate variability is vital in addressing livelihood vulnerability to climate shocks, studies that link climate variability to rural livelihood responses and changes are few (Smucker &Wisner, 2008). However, researchers have emphasized the need to establish these link as well as its impacts as a key step in adapting to its effects (Batisani & Yarnal, 2010). Researchers have emphasized that climate change inflict harsh and extreme environmental conditions upon rural smallholder farmers and therefore reduces the livelihood options of poor farm households, especially within the agricultural and livestock sector (Brown & Crawford, 2008). This gap is particularly true in remote localities like Gadamoji division. A study in Moyale and Marsabit, for instance, concluded climatic variability as a major risk in the region and recommended further research studies on long-term, site-specific effects as well as local perceptions of climate risk. (Little et al, 2001).

Moreover, there is increasing recognition that the traditional global study on climate change has little local and regional specificity thus often fail to address the regional and local impacts and the local abilities to adapt to climate change effects. Further, it was recognized that due to minimal standard definitions, absence or difficulty to get benchmark data, it's not easy to predict household climate change impacts and adaptation strategies at international level. Therefore, as strong imperative to understand the actual dynamics of climate change impact and adaptations at the lowest levels of the society, such as households, communities and districts were suggested (Deressa et al, 2008).

Due to the risks arising from climate variability, communities especially those in semi-arid environments whose livelihood are strongly impacted by the effects of climatic dynamics have developed specific response to it over the years. However, studies have shown that some of those mechanisms increase their vulnerability to climate shocks instead of reducing them hence need for improved understanding (Lioubimtseva & Henebry, 2009).

1.2 Statement of the Problem

Northern Kenya is generally considered as a region vulnerable to effects of rainfall and temperature variability that are part of key climate parameters. In Marsabit County, climate variability has characterized the region for decades on-end. Every year, local population witnesses emergencies of new climatic patterns with more severe effects to their climate-based livelihoods than previous years. Besides, they spend invaluable efforts and resources to reduce its multiple effects which often manifest in form of biting hunger, livestock losses and acute water crisis in the area (Saku District Development Plan, 2008-2012).

The study area, Gadamoji agro pastoral zone, used to receive predictable rains that were well synchronized with planting seasons resulting to abundant yields from crop and livestock. This made the area a key food-basket within and beyond the district featuring always on top of district welfare ranking in the greater Northern Eastern districts. In recent years, however, the area has lost these glories. This was as a result of combined effects of persistent crop failure, livestock loss, acute water crisis and other social factors. Consequently, the division was infamous for heavy and continuous reliance on relief rations and a target for numerous emergency interventions from various stakeholders. Indeed, attempts to explain what might be happening are rife among the local population ranging from myths to spiritual dimensions of the perceived changes particularly to rainfall patterns. Premised on conviction that people must understand and internalize the changes prior to embracing and innovating strategies to live with, this study was conceived to assess people's perception on the variability and its perceived impacts on their livelihood. It aimed at answering the question; how local people do perceives these changes and its impacts on their livelihoods.

Prompted by unfolding climate uncertainty and its adverse effects on their nature-based livelihoods, local agro-pastoral households have been employing various response strategies to cushion themselves from the effects of the shocks. Increasingly, most households are changing their livelihood strategies with changing climatic hazards. Some of these response strategies could potentially form bedrock for adapting to current and future climate variability but remains largely unknown and in some cases ignored by development agencies and academia. Indeed, there are growing calls that poverty reduction should prioritize adaptation to climatic conditions based on existing local strategies hence need to understand these strategies (Batisani et al, 2010). This study identified these strategies at the households' level in Gadamoji division to adapt to the prevailing climatic condition.

It also explored and provides menu of some emerging and desired livelihoods options which if well supported would enhance community resilience to future climate-related shocks, enable local population to meet their needs as well as serve as a guide for livelihood interventions in the region.

1.3 Research Questions

The research was guided by the following questions;

1. How do agro-pastoralists in Gadamoji division perceived climate variability and its impacts?

2. What livelihood responses strategies are employed by local agro-pastoralist households to adapt to climate (rainfall and temperature) variability in the period 1998-2012?

3. What livelihoods interventions can be explored to enhance resilience of local agro-pastoral households to effects of future climate change?

1.4 Research Objectives

The general objective of the study was to understand perception of climate variability and livelihood response strategies among the Gadamoji agro-pastoralists of Marsabit district in Marsabit County, Kenya.

The specific objectives were to;

1. Assess perceptions of climate variability and its impacts on local livelihoods among the Gadamoji agro-pastoralists of Marsabit district.
2. Identify livelihoods response strategies used by Gadamoji agro-pastoralist households to adapt to climate (temperature and rainfall) variability in the period 1998-2012.
3. Explore livelihoods intervention options that enhance resilience of local agro-pastoral households' to effects of future climate change?

1.5 Research Hypotheses

1. Gadamoji agro-pastoralists have not perceived climate variability phenomena and its impacts on their livelihoods.
2. Local agro-pastoralists households in Gadamoji are not employing livelihood response strategies to adapt to climate variability in the period 1998-2012.
3. There are no livelihoods intervention options to enhance resilience of Gadamoji agro-pastoral households' to effects of continued climate change.

1.6 Limitations of the Study

This study was conducted in Gadamoji division and the responses presented are from selected respondents. The findings therefore were valid for similar location and may not be representative to generalize to locations with dissimilar social and physical setting. Similarly, data on perception of climate variability and its impacts on livelihoods as well as livelihood responses were from selected respondents based on their past experiences which may slightly differ with locations.

In addition, climate variability is a research area which requires long timeframe involving many parameters. This study however was limited to only rainfall and temperature as well as people's livelihood responses to the variability in the period 1998-2012 i.e. fifteen years preceding the study.

1.7 Significance of the Study

The study gauged the perception of local people on climate variability and its impacts on their livelihoods. It not only enhanced understanding of how local people understand climate variability but also provided a basis for developing climate awareness and information at various levels.

It also documented current livelihood response strategies which would serve as a foundation for designing and planning responses to effects of future climate change and contribute to conservation of key capitals. It provided key information to assess how livelihoods have changed over time and identified initiatives and practices upon which future adaptation would be based. Further, the desired response options identified would be a guide in integrating adaptation in local, national and regional development plans, program and policies for maintaining livelihoods among the agropastoralists.

The study also explored livelihood support options in the area which would serve as a potential shopping list for government and development stakeholders engaged in fund-raising for climate change adaptation program as well as in designing social protection and livelihood supports program.

In undertaking the study, the researcher assumed that the respondents gave honest and accurate information especially given that interviews were conducted by interviewers familiar to them. The questionnaires also had an inbuilt internal verification to test the accuracy of the responses.

Further, due to potential difficult to make a clear distinction between households coping mechanisms and adaptation strategies, the study assumed and considered both schemes as livelihood response strategies.

1.8 Definition of Terms

Climate change impacts refer to the extent of damage inflicted by climate change on livelihoods and social system (Deressa et al, 2008).

Adaptation is any adjustment that takes place in natural or human systems in response to actual or expected impacts of climate change aimed at moderating harm or exploiting beneficial opportunities (Deressa et al, 2008).

Livelihood refers to assets and activities that determine the living gained by the individual or households (Ellis, 2000).

Livelihood adaptation strategies are the way household respond to adverse climatic effects, cycles, and trends. Successful adaptation strategies mean one the household became less prone over time without compromising future survival (Ellis, 2000).

Climate variability is deviations of climate statistics over a given period of time, such as a specific month, season or year, from the long-term climate statistics relating to the corresponding calendar period (IPCC, 2007). For this study, perception on rainfall and temperature variability, the two key climate parameters, were studied.

Household is a group of individual who in the same dwelling and eat from the same pot (Ellis,2000)

CHAPTER TWO: LITERATURE REVIEW

2.1 Climate Variability and Impacts on Livelihoods

The impacts of climate change phenomena are of global concern in the 21st Century. It is emerging as an unprecedented challenge to development in general and poverty reduction in particular especially in arid and semi-arid regions where millions of rural people live. Africa is one of the most vulnerable continents to climate change and variability partly due to high reliance on livelihoods sensitive to climate change (IPCC, 2007). In African Sahel, decrease in rainfall was noted as directly affecting rural communities whose livelihoods are rain-dependant. This is projected to result to reductions in agricultural yield to as much as 50% by 2020 in some countries thereby directly affecting small-scale farmers (IPCC, 2007).

With recognition that rainfall variability brings droughts, floods and negatively affects livelihood, understanding today's variability is viewed as a key to building people's adaptive capacity (Batisani et al, 2010). However, much scientific work on climate variability has focused on the global and regional levels with little emphasis on the local context yet climate impacts and responses measures are most felt at the local levels (Deressa et al, 2008). It is also increasingly recognized that social science research focusing on behavioral realities of climate change impacts and individuals' ability to adapt to those impacts are critical in ameliorating its effects (Smith et al, 2012).

In most semi-arid areas, rainfall variability is a key climate feature that is projected to increase in many regions in Africa with changing climate. Understanding its trends is thus paramount to addressing both current climate variation and future climate change (Batisani et al, 2010).

This is especially true with growing evidence that future climate change would likely increase temporal and spatial variability of temperature and precipitation in many regions in Africa with its multiple impacts on rural livelihoods (Batisani et al, 2010).

Kenya is not spared from the impacts of climate change with future economics costs of its impacts estimated close to 3% of Gross Domestic Product (GDP) per year by 2030 (Mutimba et al, 2010). Indeed, Kenya's Arid and Semi Arid Lands (ASALs) are exhibiting pronounced signs of climate change which includes shift in intensity and seasonality of rainfall, prolonged droughts and severe flood events. Studies in these areas acknowledge climate variability as a major threat to people's livelihoods due to its adverse impacts on food production, water availability and people's low adaptive capacity (Obando et al, 2009).

As result, decision makers are keen to examine climatic variability and change in the past, present as well as future projections to make decisions on its responses (Lioubimtseva et al, 2009). A key step in doing was to understand perception of the local people and their response strategies which this study did in Gadamoji Saku district of Marsabit county (Batisani et al, 2010).

2.2 Local Perceptions and Awareness

Despite varied impacts associated to climate change, the level of understanding and awareness on climate variation remains low and varied between regions. In United State (US), for example, climate changes are ranked low among the public as many people perceived it as spatially and temporally remote risk (Poortinga et al, 2011). In Kenya, though El Niño phenomena of 1997/98 and increased frequency of weather extremes has raised national awareness of global climatic processes, awareness on climate variability remains varied among various groups.

While scientists explain it in terms of global warming phenomena, local people use indigenous knowledge, believes and environmental indicators to conceptualize it (Poortinga et al, 2011). A study on climate awareness in Kenya indicate that although majority of people in rural areas acknowledge climate has changed, and continues to change, many are at loss when it comes to explaining the cause and effects of the problem (Mutimba et al, 2010).

However, researchers have noted that in order to embrace climate change as a new challenge and focus interventions on smallholders, knowledge on public perceptions and attitudes is of prime importance. Indeed, there is growing recognition that climate variability and people's perception is key in understanding climate-livelihood adaptation. (Poortinga et al, 2011). This is mainly because the awareness of the effect of climate change on economic activities for which individuals depend on could make individuals more motivated to plan to adapt to any potential impact (Smith et al, 2012).

However, going by the number of available literatures on awareness, this seems to have elicited little interest from many researchers. A study done in Shinyanga rural district showed that the local communities were aware that climate has changed and blamed it for increasing household vulnerability to food insecurity, acute water problem and deteriorating livelihoods. It also found out that different socio-economic groups of households (the well-off, intermediate and poor) pursue multiple adaptation strategies which the researchers recommended for future adaptation planning (Deressa et al, 2008). Such conclusion further emphasizes the need for undertaking location-specific studies to build a basis for future response options to growing climate risks.

2.3 Adaptation to Climate Variability

Communities living in the regions prone to rainfall variability have over the years developed mechanisms to adapt to its effects (Batisani et al, 2010). However, the speed of current climate change is feared to likely exceed the limits of adaptation in many parts of the world (IPCC, 2007).

Therefore, adaptation has become a key focus among development and policy makers including the UN Framework Convention on Climate Change in recent years. (Eriksen et al, 2005). This partially arise due to the observation that as variability in climatic elements increases, the vulnerability of rural livelihoods and the ability of smallholder household's to deal with its shocks and stresses increases. As a result, most households are forced to innovative risk management responses to minimize the effects (Lioubimtseva et al, 2009). These measures that occur at different scales (i.e. household, private sector, government institutions, and local, national) are sometime categorized as immediate coping strategies and long term adaptation measures.

In most cases, the distinctions between the two are somewhat fuzzy. While coping strategies are involuntary and short-term actions by communities, households or individuals when faced with adverse impacts of climate change or natural hazards, adaptation may involve broader responses to stress, such as changing income sources, migration or other significant livelihood changes (Lioubimtseva et al, 2009; IPCC, 2007). However, while climate change and its effects have come to dominate the agendas at various levels, the sociologically informed literature on climate adaptation remains limited (Smith et al, 2012).

Increasingly, it is realized that sustainable development and household food security of small-holder farmers in developing countries depends highly on their ability to cope with several risks affecting their livelihood. There is therefore a growing call for integrating farmer tactical strategies to manage climate risk to current development priorities. The question on knowledge of these strategies thus remains critical. This therefore makes any study on advancing such knowledge essential and relevant and timely. This is because in order to improve the ability of communities and households to effectively adjust to ongoing and future climate variability and change. There is need to enhance understanding on the risk they are facing (Cooper et al, 2008).

Northern Kenya like most arid and semi-arid areas are prone to varied socio-economic challenges such as endemic poverty and restricted access to capital, making adaption more difficult (Lioubimtseva et al, 2009). In Saku district, large proportion of population relies on rain-fed agriculture which makes frequently experienced rainfall variability a real challenge to rural livelihoods and food security. This has set off various adaptive responses among households with some rural households shifting from on-farm to environmentally destructive off-farm livelihood strategies (Obanda et al, 2009).

A study in Mandera and Turkana with similar geographical and livelihood characteristic to the study area, for instance, found that firewood, pole and charcoal sells are the key livelihood options employed by pastoralists and agro-pastoralists to cope with effects of changing climate (Obanda et al, 2009). This bring to fore the need for understanding livelihood adaptation strategies as well as exploring sustainable options to cope with future changes

Though involving both long-term and short-term options are commonly believed as a winning adaptation strategy, this study focus more on long-term adaptation responses as opposed to the short-term, reactive, and spontaneous coping options. Further, despite several adaptation options adopted by most households, the often debilitating effects associated to climate change shows that these strategies are not sufficient.

Moreover, the link between climate variability and household livelihood response strategies remains largely unexamined. Nonetheless, consensus are growing that improving the ability of communities and households to adjust to effects of ongoing and future climate change impacts as well as developing long-term adaptation planning requires understanding of local practices (Lioubimtseva et al, 2009). This is informed by growing believes that while climate change is a global phenomenon, adaptation is site-specific issues that require site specific knowledge and experience (IPCC, 2007).

Furthermore, knowledge on responses identifies strategies with diverse characteristics for decision making purposes; i.e. those strategies whose impacts may increase exposure to other adverse effects, those that addresses multiple aspects of households' vulnerability or those which will remain useful regardless of the existing future climate uncertainties (Poortinga et al, 2011).

There is also an increasing recognition that past policy responses to climate change impacts and anticipatory interventions aimed at enhancing household resilience has been based on educated guesses'. This is central because the process of climate change cannot quickly be stopped but we can find some adaptation strategies for community resilience against the climate change impacts. It makes it imperative to understand the livelihood options available to the poor and to sustain the livelihoods of those living in ecosystems. (Assan et al, 2009).

2.4 Literature Gaps

While a key pre-requisite for adapting to climate variability at any level is to understand and internalize it, lack of scaled-down information and awareness on climate variability remain low (GOK, 2010). Indeed, an opinion poll conducted between 2007 and 2008 showed that over 44% of Kenyans majority of whom are rural people are unaware of climate change or the opportunities in it (Mutimba et al 2010). With growing calls for poverty reduction measures to prioritize adaptation based on existing local strategies, the need to understand these strategies are more imperative than ever before (Batisani et al, 2010).

However, though climate variability are indentified as a major setback to development, efforts, the National Climate Change Response Strategy (NCCRS) note lack of area-specific information on climate as a key gap in building future adaptive capacity (GOK, 2010).

This is particularly true among the rural communities in Northern Kenya. Indeed, a study in Moyale and Marsabit while concluding climatic variability as a major risk in the region recommended further research studies on long-term, site-specific effects as well as local perceptions of climate risk. (Little et al, 2001).

Furthermore, the need to explore agricultural strategies to adjust local livelihoods to changing climatic condition prominently featured in Saku District Development Plan of 2008-2012 (Saku District Development Plan, 2008-2012).

This study therefore sought to fill these literature gaps on local climate information and adaptation strategies. In fact, the variable climatic condition, fragile ecological environment, population pressure and land degradation makes the Gadamoji division a typical representative of agro pastoralists in Marsabit County in particular and Kenya focus for this academic study.

CHAPTER THREE: RESEARCH METHODOLOGY

3.0 Introduction

This chapter presents research procedures and techniques that were employed in the study. It includes research design, population, sample and sampling procedures, instrumentation, and data collection procedures and data analysis techniques.

3.1 Study Area

The research was conducted in Gadamoji division of Saku district. It is lies between Longitudes 37° 60'E and 38° 2'E and Latitudes 2° 15'N and 2° 13'N. It has semi arid climatic condition with annual rainfall ranges between 700 mm to 2592 mm with 77% of the precipitation occurring in the long rains (April – May) and 2% in the short rains (August - September). It has average temperature of 20° 5C with 16.2°C and 24.8°C as absolute minimum and maximum temperatures respectively. February and March are the hottest months while June and July are the coldest months. The main soil types are dark brown cambisol with high fertility and fervasol/luvisols that support diverse natural vegetation and food crops. There are no permanent rivers in the district but mountain run-offs provide temporary surface water in the lowlands which provide water sources for both domestic and livestock use as well as nurture plants from crops and pasture lands. The district is characterized by high poverty level with absolute poverty at 92%, food poverty at 83% and hardcore poverty at 68%.

Gadamoji division was chosen for this study because the inhabitant, agro-pastoral communities, practices livelihoods (subsistence crop farming and livestock rearing) that is sensitive to climatic variables hence an ideal geographical focus for the study (Saku District Development Plan, 2008-2012). See appendix III for the location of the study area.

3.2 Study Design

This study used descriptive research design whereby both qualitative and quantitative data was collected and analyzed from a portion of population to gain better understanding of people's perception and responses on climatic phenomenon.

The design enabled generalizing the findings to a larger population of agropastoralists in Saku district due to its high degree of representation

3.3 Study Population

Agro-pastoral communities living in Gadamoji division of Marsabit district formed study population which is ecologically fragile and susceptible to frequent droughts (Obando et al, 2010). The division has three administrative sub-locations in total and all the sub-locations were targeted by the study.

Below are the total households in each of the three sub-locations that formed the study population.

Table 3.1: Household Population in the Division

No.	Sub-locations	Total households
1	Dirimb Gombo	452
2	Badassa	355
3	Boru Haro	528
	Total Households	**1 335**

Source: (Kenya National Bureau of Statistics, 2010)

3.4 Sampling Procedures

The sample population was drawn from households in three sub-locations in Gadamoji division. Namely; Dirib Gombo, Baddassa, and Boru Haro.

The sample size was obtained from four sub-locations. According to Mugenda & Mugenda (2003), sample size of between 10 and 30 % is a good representation of the target population. To this effect, the study used 10 % of the target households' population of 1335 which gave 133 households. This means in each sub-location chosen, a sample size of 10 % of all households were interviewed. Given the homogeneity of the population, this sample size was representative of the study population.

3.5 Data Collection Instruments

The study used structured questionnaires and interview guides. The questionnaires were structured to include both closed and open-ended questions to allow variety. These types of questions are easy to formulate and allow the respondent to present their feelings on the subject matter enabling a greater depth of response. Questions where respondents were presented with a range of questions against a respond based on a predetermined rating scale was also utilized. This was used to measure people's perceptions of the climate variability and impacts.

In addition, three Focus Group Discussion (FGDs) guide was used to collect data from community leaders in the four sub-locations who are recognized repositories of collective local wisdom and historical memory.

The group involving 6-12 participants addressed community level response strategies; cross-check and supplement information received from households' respondents as well as community level supports options in light of future effects of climate change.

3.6 Data Collection Procedures

Information on research was disseminated through chiefs, elders and youth and a comprehensive questionnaire for households' interviews and an interview guide (both appended) for FGDs at the sub-location was developed and administered. Three research assistants who had firsthand knowledge of the area were trained to help in data collection. The language used for the interviews and group discussions was Kiborana and the researcher assistants were fluent speakers of the local language.

3.7 Data Analysis and Presentations

The key data involved local people's perceptions of climate variability and perceived impacts on livelihoods, livelihood response strategies and possible livelihoods support options. The returned questionnaires was checked for consistency, cleaned, and the useful ones coded and analyzed using descriptive statistics by applying the Statistical Package for Social Science (SPSS V.17.0). The quantitative summary of the findings were presented through percentages, tables, deviation and frequencies.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.0 Introduction

This chapter discusses the interpretation and presentation of the findings. The general objective of the study was to understand the perceptions of climate variability, impacts and livelihood response strategies among the agro-pastoralists of Gadamoji division in Saku district, Kenya. In particular, it sought to assess perceptions and identify households response strategies to effects of climate (temperature and rainfall) variability in the period 1998-2011 as well as explore livelihoods intervention options that would enhance resilience of local agro-pastoral households' to effects of future climate variability and changes.

A total of 133 questionnaires were administered to household respondents and three Focused Groups Discussion (FGDs) done at each sub-location where study samples were collected. Hundred and thirsty (130) questionnaires were filled, returned and used for analysis making 98 % (percent) return rate. The interviews were done face to face within an average time of 25-35 minute whereby respondents were treated as 'carriers of information' to extract as much information as possible. The three FGDs interviews were particularly helpful in clarifying gaps left by household interviews as well as enrich the findings. The results of this study are presented in tabular and graphical formats.

4.1 Respondents Information

This section present results of age distribution and income generation activities of the respondents. Gender and other basic information of the respondents are integrated in the result of data analysis.

4.1.1 Age Distribution

The age distributions of the respondents were ideals as it captured ideas of young adults, middle age adults and old ages. Table 4.2 shows that majority of the respondents were between 25 and 45 years (33% of the respondents) while 25% were aged between 35- 45 years. Also captured were young adult aged below 25 years (18% of the respondents) while 14% and 9 % of the respondents were old aged above 55 years and between 45- 55 years respectively.

Respondents within the age bracket of 25-45 years are key participants in decision making at households levels hence in a good position to provide households information and also play important role in generating livelihoods activities.

Age was also considered important because it could determine family's adaptation capacity and future adaptation direction in one way or another.

Table 4.2: Age Distribution

Respondents Age bracket (Years)	**Frequency(F)**	**Percentage (%) N=130**
20-25	21	16
25-35	44	34
35-45	33	25
45-55	12	9
Above 55	20	15
Total	130	100

4.1.2 Income Generating Activities

Table 4.3 shows that majority of the respondents, 24% (n=130), consider livestock keeping as their main income generating activity. 22.4 % consider wage employment while 22.2 % accrue their main income from sale of firewood, charcoal, local brews and construction poles classified as others.

In addition, a significant proportion of 12.6% of respondents source their income from khat (miraa) sale. From the analysis, it was evident that majority of the respondents relies heavily on livestock. This can be attributed to their pastoral background and semi-arid nature of the region which manly supports livestock.

The study also revealed that the respondents have practiced agro-pastoralism for 45 years on average with a standard deviation of 9.2. This shows that they had done it for a long time hence stands a good position to share experiences.

Table 4.3: Income Generating Activities

Income Generating Activities	**N= 130 Percentage (%)**	
	Households Count (F)	**% of Households**
Sale of crop	3	2.1
Livestock Keeping	31	24
Formal Employment	6	4.4
Bee Keeping	4	3.4
Bussiness	12	8.9
Wage Employment	29	22.4
Khat Sale	16	12.6
Others	29	22.2
Total	**130**	**100**

4.2 Perceptions on Climate Variability and Impacts on Livelihoods

This section presents the results of the perception of climate variability and its impacts on local livelihoods in Gadamoji division according to the respondents interviewed.

4.2.1 Perception on Climate Variability

Household respondents were asked whether they noticed any change in average temperature and rainfall over the past 15 years (from 1998) preceding the study.

The analysis in table 4.4 indicate that 93.7% (n=79) of the respondents had noticed change in the average temperature and rainfall while only 6.3% had not noticed any change in period of 15 years preceding the survey. All respondents who reported noticing the changes admit that the changes are adversely and significantly affecting their livelihoods.

Analysis of responses by gender shows that 97.8% and 87.9% of males and females respectively had witnessed a change in the average rainfall and temperature while 2.2% and 12.1% of the males and females had not.

The difference in perceptions could be viewed in terms of different roles played by male and female and how climate variability affects them. As a patriarchal society, men are the breadwinner thus prone to climatic effects that affect their livelihood assets and their roles to provide for the family. Nevertheless, the results of the chi-square analysis showed that there was no significant difference at 5% level of significance between the number of females and males who had witnessed the climate variability in the area (χ=3.2, p=0.07).

Table 4.4: Perception on Climate Variability

			Climate Variability		Total
			Yes	No	
Gender	Male	Count	96	1	97
		% within Gender	99%	1%	100%
	Female	Count	29	5	33
		% within Gender	88%	12%	100%
Total		Count	124	6	130
		% within Gender	95 %	5 %	100%

Respondents were also asked on aspects of rainfall and temperature they noticed had changed. 99% (129) noticed widen rainfall spacing between seasons and shorten rain period while only 1% (1) disagreed saying rainfall spacing between seasons has narrowed (rains early) and rain period (season) extended. However, respondents (100 %) unanimously admit noticing changes in rain onset, cessation period as well as cycles of failure over the past 15 years. On the temperature, 97 % (126) of the respondents reported noticing increase in temperature in the area.

Table 4.5: Perception on Aspects of Climate Variability

Climate aspects	Perceptions	Frequency (F)	% of respondents(n=130)
Rainfall Amounts			
	Increased	10	8%
	Decreased	120	92%
Rainfall Spacing			
	Widened	129	99%
	Narrow	1	1 %
Rainfall Time (Season)			
	Shortened	129	99%
	Extended	1	1 %
Rainfall Onset and Cessation			
	Delay onset &Early ends	130	100%
Rainfall Failure			
	Yes	130	100%
Temperature		0	
	Increased	126	97%
	Decreased	4	3 %

From the analysis, it is clear that majority of the local people are aware climate variability is real and happening. The fact that they are able to point out key aspects of changing climate factors shows their level of climate sensitivity. They understand that these changes are not phenomenal which are usually cyclically or seasonally

This finding agrees with similar study on perception done in 13 ASAL divisions in Kenya in 2011 which established that an overwhelming majority of farmers (96 %, n= 710 households) perceived increased in average temperature and 91 % of the respondents perceived variability in rainfall (Bryan et al, 2011). The finding was also collaborated by the data from Kenya Meteorological Department (KMD) which shows an increased in temperature in the region over the last fifty years (1960-2010) between 1.0 -1. 3 C (GOK, 2010).

Furthermore, respondents were asked on aspects of rainfall variability that posed great challenges to their livelihood in the period 1998-2012 9 (15 years preceding the study). 53% (55% male and 51% female) of the respondents mentioned rainfall failure with a case of rain failures in 2010, 2009 and 2011 repeatedly cited by respondents. 19% (23% male and 17% female) and 21% (22% male and 20% female) of the respondents believed widened rainfall spacing and shortened rainfall season respectively as great challenges to their livelihoods. However, 7% (7% male and 7% female) of the respondents think any deviation from normal rainfall trends negatively affect crop and livestock hence their livelihoods. This was concisely captured by comment from one of the respondents, Habiba Galgallo, *"When rains don't come, or come too early or late, it spell disaster to us, because we depend on rain for survival.* (Dirimb Gombo Household Interview, 2012). This shows their ability to analysis different aspects of climate variability and its link to their livelihoods. Nevertheless, at 5% level of significance, there was no significant difference between males perception on the aspect of rainfall variability with the females (χ=1.94, p=0.119). This is shown in figure 4.1 below:

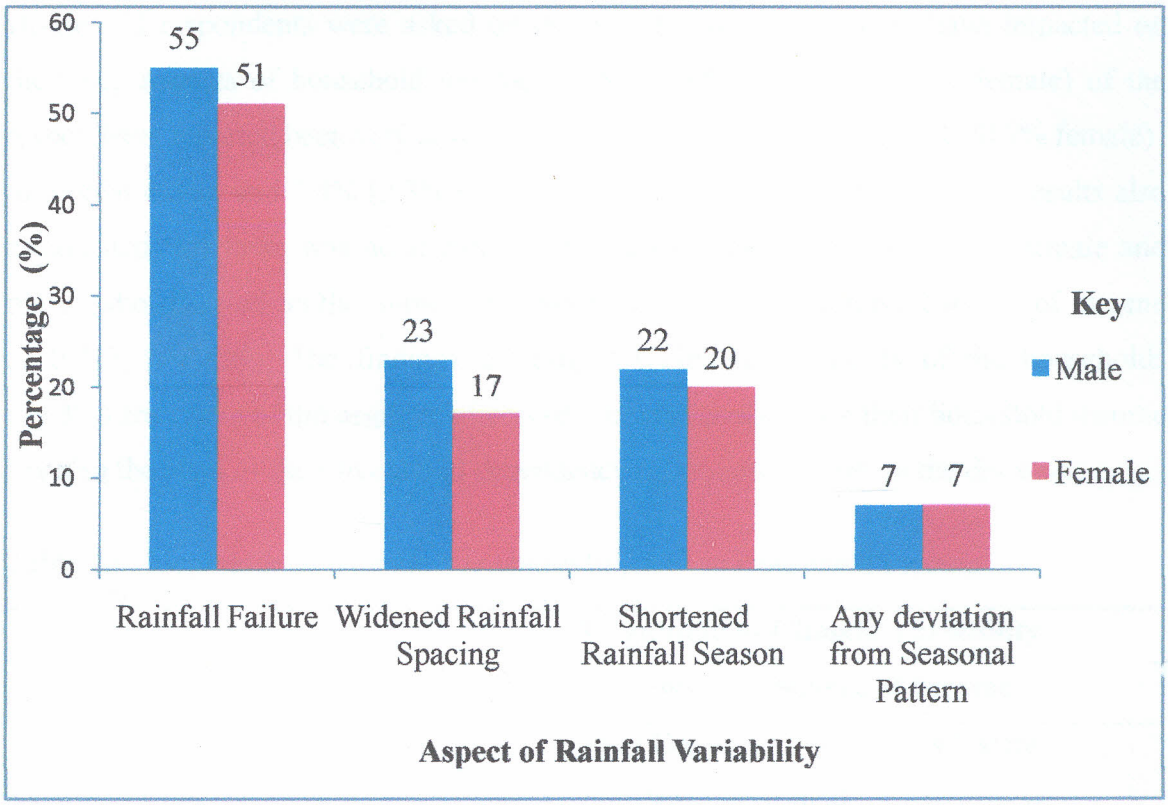

Figure 4.1: Rainfall Variability and Livelihood challenges

These findings are similar to a number of other studies on climate done in Kenya. The NCCRS note that rainfall variability manifested in terms of amount, distribution and frequency have had adverse impacts on productive asset and personal possessions of people particularly those living in ASAL areas (GOK, 2010). A study by Musiba et al 2010, also found out rainfall variability as a key challenges to subsistence farmers like agro-pastoralist in Gadamoji division (Mutimba et al, 2010)

4.2.2 Perceived Magnitude of Climate Variability Impacts

Household respondents were asked on the extent climate variability have impacted on their key sources of household income. 79.5% (79.5% male & 79.3% female) of the respondents reported been very severely affected, 19.2% (18.2% males & 20.7% female) to a great extent and 1.4% (2.3% male & 0% female) to a low extent. The results also established that there was no significant difference between the number of female and males who reported on the impact of climate variability on household source of income (χ=0.717, p=0.699). The findings not only revealed that majority of the households (79.3%) are aware of the negative effects of climate variability on their household income but also the level of their livelihood dependency on climatic factors in the division.

Table 4.6: Magnitude of Climate Variability Impacts on Household Income

			Magnitude of Climate Variability on Household Source of Income			
			Very Great Extent	Great Extent	Low Extent	
Gender	Male	Count	82	19	2	103
		% within Gender	79.5	18.2	2.3	100
	Female	Count	21	6	0	27
		% within Gender	79.3	20.7	0	100
Total		Count	103	24	2	130
		% within Gender	79.5	19.2	1.4	100

Further, respondents were asked to state how climate variability affected their livelihoods in the past 15 years preceding the study. 89 % (n=130) of the households mentioned frequent poor yield from crops while 92 % (n=130) reported reduced or complete loss of livestock holdings due to drought (key aspect of climate variability). The picture below taken by researcher in the neighboring division of Bubisa in 2009 exemplified the point.

Plate 4.1: Drought impacts on livestock in Saku District during drought in 2009 (Source: Author's photo library, July 2009).

A study on Kenya's climate change preparedness and vulnerability done in 2010 agrees with the above finding. It notes that livestock keepers and subsistence farming faces the brunt of climate change in form of prolonged rain failure. Indeed, it was estimated that in 2009, most pastoralists lost more than half of their herds to droughts (Mutimba et al, 2010).

In addition, 83.5 % (n=130) of households' respondents believe climate variability has increased household poverty (i.e. increased household inability to meet various domestics and social obligations e.g. paying school fees) while 96.4 % attributed increase in food insecurity and dependence on relief foods to effects of climate variability.

The analysis also showed that 68.8 % of the respondents thought climate variability had resulted to acute water shortage and increased household costs (in term of expenditure and time) in accessing water for both livestock and domestic use in the division. Another 54 % of the respondents noted decrease and/or disappearance of forage species; a condition blamed for reduced livestock yield and their vulnerability to effects of drought. See the table 4.7.

Table 4.7: Perceived Impacts of Climate Variability on Livelihoods

Perceived Impacts of Climate Variability in the Period 1998-2011	**Male**		**Female**	
	Count	**% N=97**	**Count**	**% N= 33**
Poor crops yield	88	91	29	87
Decrease and/or Loss of Livestock holding	86	89.1	30	91
Increased Households Poverty and Social ills	82	84.5	27	82.5
Food Insecurity and Dependence Relief	94	96.5	32	97
Increase Water shortage and Cost on Water	68	70.2	22	65.4
Disappearance of forage species	54	56	17	52

A study in Northern Kenya by Obando et al (2009) on climate effects concurs with the above findings and blame climate variability for increase general poverty in the region (Obanda et al, 2009). The finding on livestock feeds also matches with a study done in 13 ASAL divisions in 2011 where 65 % of 710 respondents attribute disappearance of livestock feeds to effects of climate variability (Bryan et al, 2011).

4.2.3 Frequency of Perceived Impacts of Climate Variability

Respondents were asked on the extent they have been experiencing some environmental conditions thought attributable to climate variability in terms of frequency in the division in the period 1998 -20011.

These conditions are critical to agro-pastoral livelihood and were presented in tabular format.

Water shortage was reported to occur very frequently (97.6%) followed by reliance on food aid (73.8 %) and decline in crop and livestock production (73.4%), In addition, loss of livestock or declining livestock number (71.8%), drought phenomena (67.4%), general food insecurity (57.3%), vegetation/pasture degradation (54.1 %), change in local weather pattern (52.3%) and repeated crop failure (47.1%) were reported to have occurred to a great extent. Though cases of household members temporarily moving to urban centres to seek employment were reported, household in/out migration were reported to a moderate degree. See table 4.8 below.

Table 4.8: Frequency of Perceived Impacts of Climatic Variability

Climatic-Induced Conditions	**Perceived Frequency in the period 1998-2011 (N= 130), Percentage (%)**				
	Very Great Extent	**Great Extent**	**Moderate Extent**	**Low Extent**	**No Extent at All**
Drought Phenomena	67.4	30.2	2.3		
Change in Weather Pattern	52.3	44.2	2.3	1.2	
Severe Water Shortage	97.6	2.4			
Vegetation/Pasture Degradation	54.1	41.2	4.7		
Loss of Livestock or Declining Number	71.8	25.9	1.2	1.2	
Food Insecurity	57.3	29.3	13.4		
Increase Reliance on Food Aid	73.8	19.0	4.8	2.4	
Repeated Crop Failure	47.1	43.5	5.9	3.5	
Household in/out Migration	17.1	35.4	30.5	14.6	2.4
Declining Crop and Livestock Production	73.4	23.3	1.2	1.2	1.2
Increase Crop and Livestock Diseases	22.1	38.4	18.6	18.6	2.3

4.2.4 Perceived Causes of Climate Variability

Analysis on the perceived causes of climate variability showed an overwhelming majority (76.7%) of respondents attributing climate variability to destruction of forest as shown by figure 4.2 below. This was followed by 19.8% who believe climate variability was as result of natural causes while 1.2% (n=130) thought it was a sign of divine anger (God annoyance). Mzee Duba Galgallo, an elder from Dirimb Gombo note; "*There are many sinners in our midst and God is punishing us for their sin*". Key reason for the perceived divine anger was failure by community elders to appease ancestral spirits and rain gods through practicing traditional rituals.

The fact that majority of the respondent believe human activity (destruction of natural forest) was responsible for climate variability gives hope for possible success of interventions to address environment and climate issues in the division, It also highlight the needs for sensitization particularly to those who believe the effects are an act of God.

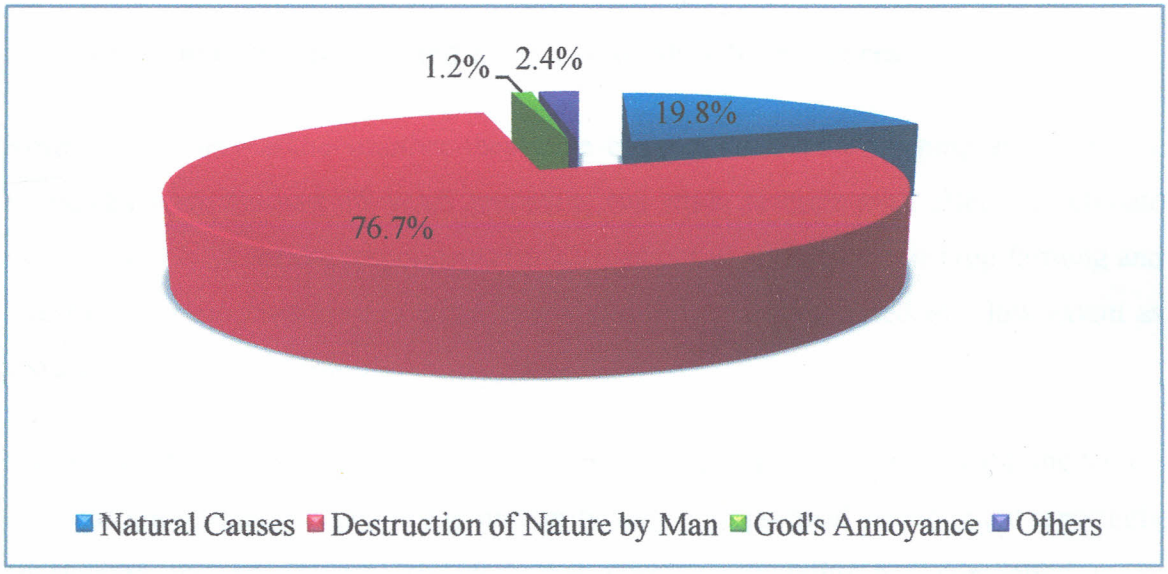

Figure 4.2: Causes of Climate Variability

In addition, respondents were asked on their perceived climate outlook and impacts. Majority of the respondents (97.7%) anticipates that climate variability and its impacts on the livelihood will worsen in future while only 1.3% of the respondents disagree with the assertion. 1 % of the respondents, however, believe only God knows how future climate outlook will be. The increased perception on future risk of climate variability gives an opportunity to capitalize on in designing climate change awareness program as well as draw local attention on building people's adaptive capacities.

The National Climate Change Response Strategy also concur with this finding noting that smallholders in rural Kenya are most vulnerable to continued and future effects of climate change (GOK, 2010).

4.3 Households Livelihoods Responses

As result of climate variability impacts on local livelihoods, most households were compelled to respond. This section outlines some of these key household level responses.

4.3.1 Adjustment to Farming and Livestock Husbandry Practices

Respondents were asked whether they have changed their crop farming and livestock husbandry over the past 15 years preceding the study to cope with effects of climate variability. 97.2% of the respondents (n=130) admitted adjusting their crop farming and livestock rearing practices to a great extent and only 2.8 % adjusted to a low extent as shown by figure 4.3 below.

It is noteworthy that though climate variability was identified as a key contributing factor, combination of multiple factors e.g. insecurity and socio-political environment reportedly accelerated the adjustment. The fact that climate variability has compelled many households to change their crop farming and animal husbandry practices indicates potential uptake and success of new response strategies in the division.

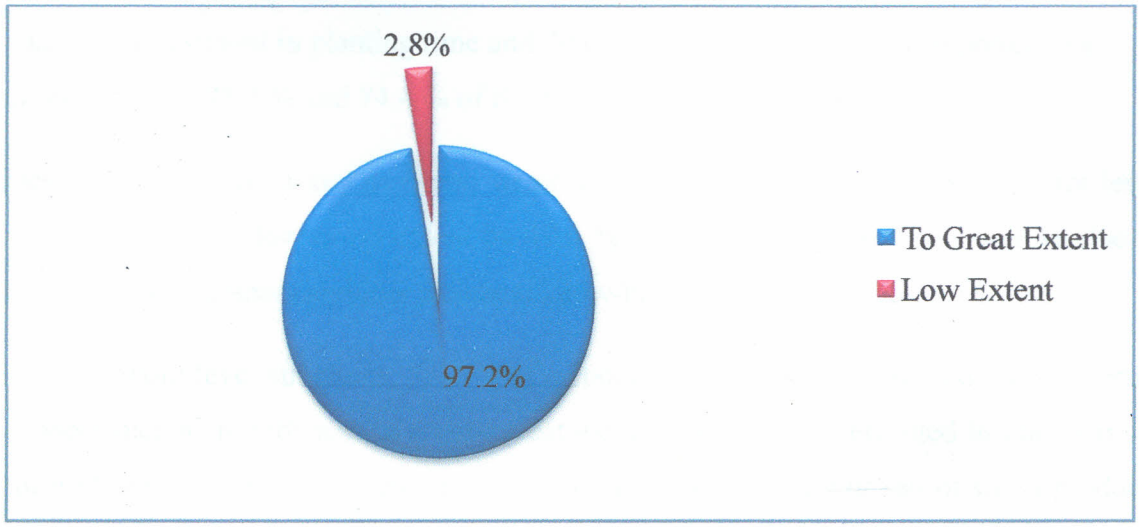

Figure 4.3: Levels of Household Adjustment Practices

The above finding concurs with results from similar study done in Tharaka on households' responses to drought where households were found to adopt multiple strategies to resist effects of droughts (Smucker el at, 2008).

4.3.2 Household Adaptation Strategies to Effects of Climatic Variability

In order to establish household response strategies to effects of climate variability, respondents were presented with list of agricultural and household-level strategies and asked to state the extent their households adopted each of the strategies to minimize effects of prevailing climatic conditions in the past 15 years preceding the study (since 1998).

As shown by table 4.9, most households (87.2 %, N=130) had changed their crop types manly from traditional staple crops (maize and bean) to other crops to a significant extent. Khat (mirra) farming has notably replaced maize and bean on most farms. Farmers report that khat (mirraa) is not only less affected by change in rain patterns and amount than maize and bean but also fetch more money.

67.1 % and 52.3 % of the respondents reported reducing their farm size and switching to early maturing and drought tolerant crop varieties respectively to a great degree. In addition, adjustment in planting time and diversifying crop planted was reported to a great extent by 75.7 % and 74.4 % of the respondents respectively.

Despite water being a key problem, water and soil conservation measures at farm level was practiced to a low or no extent by 49.9 % of the respondents. This could be due to low level of awareness and low technical know-how on the conservation measures.

On household level strategies, 83.2 % of respondents rely on food aid and other external support such as remittances to a very great extent while 65.6 % engaged in one or more form of non-farm activities (engage in casual labor, bee keeping or sell of wood products e.g. charcoal, firewood, building poles and local brews) to cope with adverse effects of climate variability. Some of these households which engage in non-agriculture activities either do not have enough livestock to rely on or crop produces to sustain them thereby forced to rely on food aid or engage in sale of labor to meet household needs.

A good proportion of households (62.2 %) practices during and pre-impact saving (reduce amount of meals, eat less preferred food, postponed family occasions) while another 59 % engages in roof rain water harvesting to cope with perennial water shortage. Other responses mentioned include reducing herd number (54.6 %), diversifying herd composition (54.1 %) and migration of household labour (41.2 %). In addition, providing supplement to livestock feeds (e.g. feed livestock with tuber), fodder preservation, engaging in credit from better-offs groups and credit institutions, sale of milk or crop produces and practicing kitchen gardening are some of the strategies sampled households relied on to adapt to the prevailing climatic conditions.

Though to a low extent, some livestock based strategies are also employed. These are: herd splitting, slaughtering of young and old animals and selling livestock to meet basic family needs.

Table 4.9 below shows analysis of the strategies

Table 4.9: Adopted Farm and Household-level Adaptation Strategies

Adaptation Strategies	**Extent of adoption by households (N= 130) Percentage (%)**				
	Very Great Extent	**Great Extent**	**Moderate Extent**	**Low Extent**	**No Extent at All**
Plant Early Maturing and Drought Tolerant Seeds	52.3	29.1	14.0	4.7	0.0
Change Crop Type	87.2	8.1	2.3	1.2	1.2
Adjust Planting Time	22.0	53.7	14.6	9.8%	
Reduce Farm Size	67.1	28.2	2.4	1.2	1.2
Plant Soil Conservation Measures	12.9	15.4	21.8	39.4	10.5
Diversify Crops Type Planted	31.4	43.0	20.9	1.2	3.5
Diversify Herd Composition	54.1	35.9	9.4	1.6	
Herd Splitting and Migration	14.4	17.9	25.1	23.3	19.3
Slaughter Young and Old Animals	1.2	29.8	35.7	20.2	13.1
Reduce Herd Number (Destocking)	54.6	24.7	16.8	2.8	1.1
Supplement Livestock Feeds	11.0	40.2	29.3	11.0	8.5
Fodder Preservation e.g. *Kallo*	23.3	30.2	41.9	3.5	1.2
Sale Livestock	31.4	16.3	24.4	11.6	16.3
Engage in Non-Farm Activities	65.6	15.6	7.8	5.0	14.0
Reliance on Food Aid, remittances and other External Support	82.3	9..8	7.9		
Roof Rain Water Harvesting	59.0	34.9	4.8	1.2	
Credit from Better-offs and local Institutions	39.5	25.6	5.8	12.8	16.3
Household labour Migration	23.5	41.2	27.1	8.2	
Adopt Pre-Impact Saving	62.3	29.5	4.7	3.5	
Sale Milk or Crop Produces	21.9	17.9	7.0	28.6	24.7
Practice Kitchen Gardening	33.3	38.1	27.4	1.2	

Among the above many household responses options, respondents were asked to state two significant livelihood changes/responses their households adopted in the past 15 years to minimize effects of climate variability and diversify their income source.

A significant percent of households (43 % , N=130) reported diversifying to off-farm incomes (wage employment or sale of environmental resources e.g. firewood, charcoals and house building materials) and small trade e.g. retail shop, butchery and miraa while 32 % of households admit changing stocks from cattle to more drought-resistant goats, camels and poultries. In addition, 15 % of the respondents adopted pre-impact saving of assets and incomes (save money, eat less, postpone social obligation etc) and 10 % of households engaged in kitchen gardening.

Plate 4.2 shows a home garden of one of the respondents, Mrs Lokho Jarso, from Badassa sub-location taken by the researcher in December 2012 during data collection exercise.

Plate 4.2.One of Kitchen Gardens (kales and pawpaw tree) in Badassa sub-location (Source: Author's photo library, December 2013).

The four strategies which summarize the salient responses adopted by Gadamoji households are presented in figure 4.4 below:

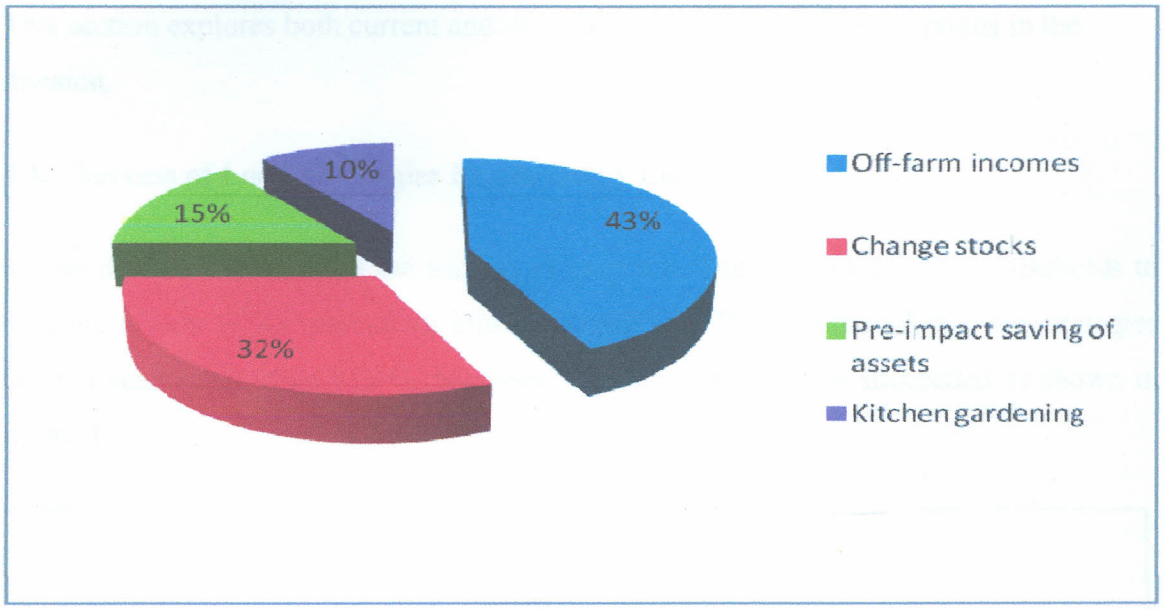

Figure 4.4: Key Livelihoods Strategies Adopted by Households

The above findings shows that all sampled households have adopted autonomous adaptation strategies geared manly toward enhancing household incomes and self reliance. This shows some levels of people's acceptance of the changing climatic situation hence the struggle to live with the effects. .The results also shows that most of the strategies are not pursued alone by households but jointly as a menu of options. This is similar to findings from others studies on household level; adaptation done in Kenya. Byran et al (2010), for example, identified changing crop type, planting time, diversified income and conservation measures as key form of households' adaptation in study on adaptation in 13 ASAL divisions (Byran et al, 2010).

In Tharaka district, a similar study on household response to drought done in 2008 also identified reliance on food aid, engaging in wage labour and livestock diversification as the main strategy. This strongly concur with the above findings (Smucker et al, 2008)

4.4 Livelihoods Intervention Options

This section explores both current and desired livelihood intervention options in the division.

4.4.1 Success of Local Strategies Employed by Local

Respondents were asked on the success of response strategies adopted by households to mitigate effects of the prevailing climatic conditions.78.6% reported that the strategies has not succeeded while 21.4% disagrees that the strategies has succeeded as shown in figure 4.5.

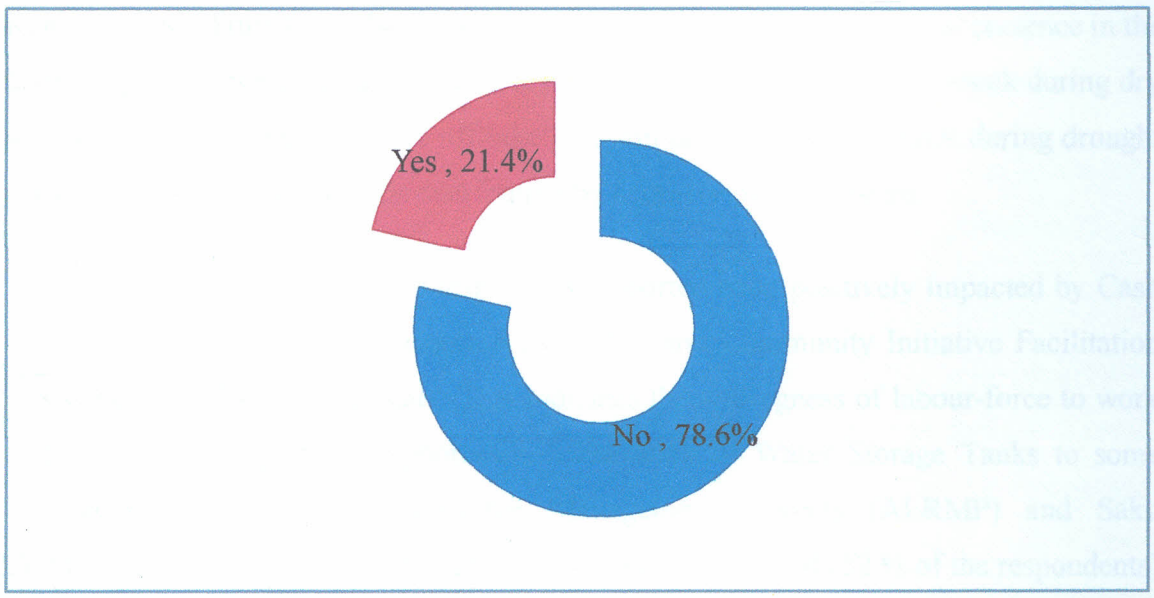

Figure 4.5: Success of the Strategies Employed by Local

Though this shows some level of success in household adaptation, interview with Focused Groups (FGs) attribute the success largely to the supports offered by development partners than as a result of household adaptation.

Indeed, it was observed that most activities undertaken by development partners' though not explicitly focused on climate adaptation per se greatly cushion households either directly or indirectly from adverse effect of climate variability.

Over the last 15 years preceding the study, a number of livelihood supports were undertaken by various development stakeholders (government or development partners) to help locals minimize adverse effect of climate variability. Respondents' were asked to state the support that impacted most positively to their households in terms of reducing effects of climate shocks in the last 5 years. 95 % reported General Food Distribution (GFDs) from World Food Program (WFP), 66 % mentioned non-conditional cash transfer provided by CARE Kenya, 8 % noted soft business loans provided by Jamii Bora and Kenya Women Trust Fund (both micro-credit institutions with operational presence in the division), 44 % mentioned supply of livestock feeds by Ministry of Livestock during dry seasons, 63 % reported livestock off-take program done by a local NGOs during drought period and 19 % reported seeds distribution by Ministry of Agriculture.

Though short-term, 67 % of the respondents reported been positively impacted by Cash For Work (CFWs) projects sponsored by CARE and Community Initiative Facilitation Assistance (CIFA) over the years. This indicates the willingness of labour-force to work and earn a living given an opportunity. Provision of Water Storage Tanks to some households by Arid Land Resource Management Projects (ALRMP) and Saku Community Development Fund (CDF) office was also reported (52 % of the respondents) as a key support which helped households managed effects of droughts. This is shown by table 4.10.

Table 4.10: Support Provided by Government and Other Developing Partners

	N = 133, Percentage (%)			
Assistance	**Male (%)**	**Frequency(N)**	**Female (%)**	**Frequency**
Provision of water tanks	53	70	51	68
Community Cash For Work	70	93	62	82
Seeds during Planting	85	113	73	97
Provision Loan	35	47	29	39
Livestock Off take	70	93	55	73
Supply of Relief food	96	128	95	126

4.4.2 Livelihood Options to Mitigate Future Effects

To explore livelihoods options preferred by households to mitigate effects of climatic variability in future, respondents were provided with list of adaptation options and asked on the extent they would prefer to adopt.

As shown by table 4.11, 73 % of the respondents (N=130) would prefer to invest in Small Scale Irrigation, 63.4 % would engage in non-farm income activities while 63.4 % would like to start new or expand existing home-based small trade. 77.6 % of the respondents would like to diversify their stocks to goats and camel citing ability to withstand harsh climatic and environmental conditions as the reason.

Other options preferred by respondents to a great extent include agro-forestry and Tree Farming (40%), joining social groups activities (52.4%), invest in livestock and crop insurance premium (40.2%), intensify domestic water harvesting and storage measures (54.9%), adopt households planning based on climatic information (48.8%), adopt farm conservation measures, seek technical advice on good agronomics practices as well as seek awareness on climatic variability and its impact (58.8%).

Table 4.11: Key Livelihood Options to Mitigate Future Effects

Future livelihood options	Level of Adoption N= 133, Percentage (%)				
	Very Great Extent	Great Extent	Moderate Extent	Low Extent	No Extent at All
Start Small Scale Irrigation	73	31.3	3.3	2.4	
Practice agro-Forestry	40.	37	18.5	2.5	1.2
Engage in Non-Farm Income Activities	63.4	25.6	6.1	1.2	3.7
Start or Expand Petty Trade	63.4	26.9	4.8	2.4	2.5
Join or Practice in Local Groups	52.4	31.7	7.3	8.5	
Invest in Livestock and Crop Insurance	39.0	40.2	9.8	9.8	1.2
Intensify Water Harvesting and Storage Measures	54.9	30.5	9.8	4.9	
Plan Based on Early Warning Information	48.8	29.3	17.1	4.9	
Adopt Conservation Measures and Technical Advice Agronomics Practices	29.3	43.9	15.9	9.8	1.2
Seek Awareness on Climatic Variability Impact	58.8	33.8	3.8	2.5	1.2
Diversify herd composition	77.6	19.1	3.3		

Finally, respondents were asked to state key constrains they would anticipate in adopting the above desired strategies to mitigate future effects of climatic variability at households' levels.

89 % of the respondents noted poverty and lack of capital to invest in climate-resilient livelihoods as the barrier, 84 % view climate uncertainty and lack of reliable climate information, 73 % mentioned inadequate knowledge on other livelihoods while 59 % think ethnic conflicts would be the key barrier as presented in the figure 4.5 .

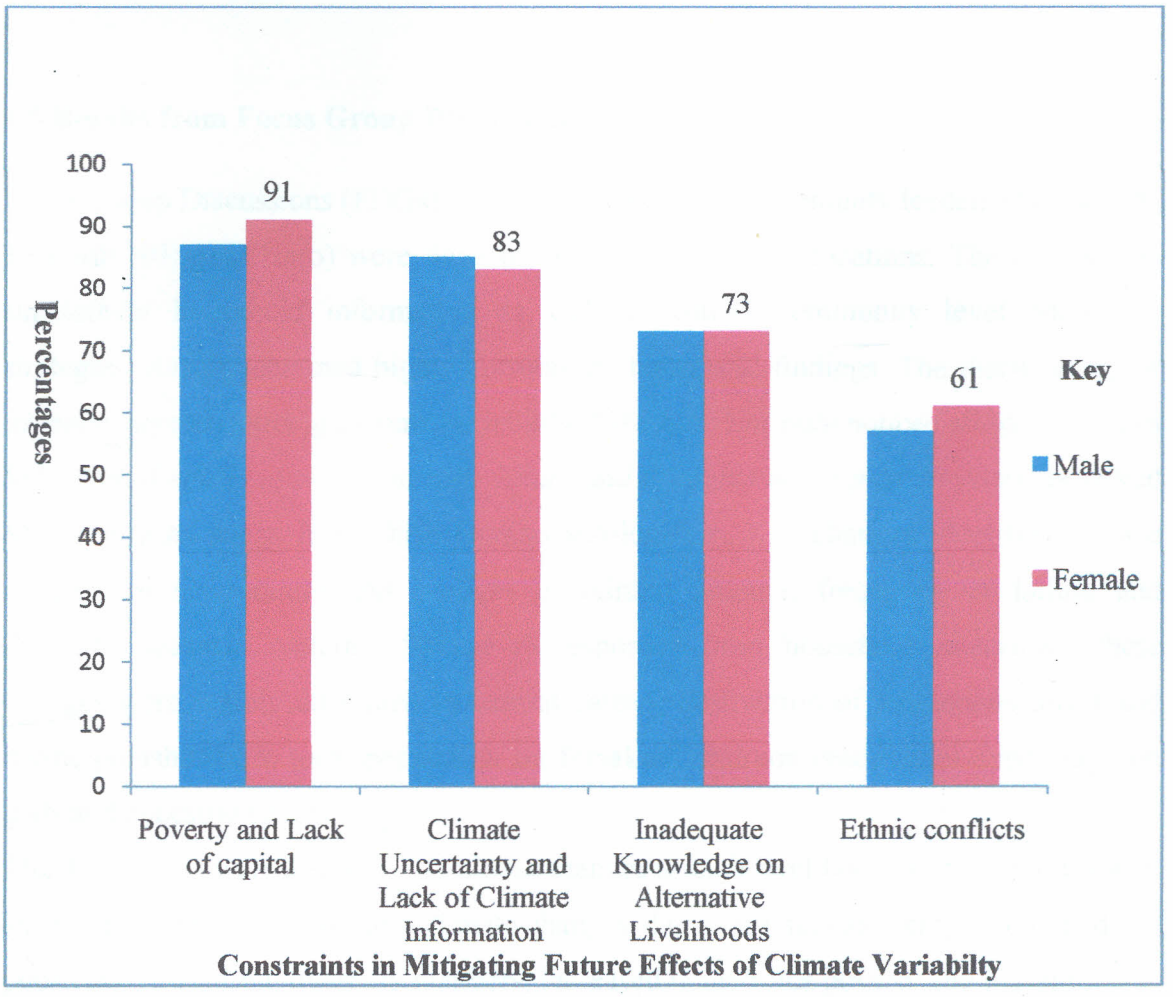

Figure 4.6: Constrains in Mitigating Future Effects of Climate Variability

From the above analysis, majority of the respondents view poverty and climate uncertainty as the key barrier to future adaptation. The desire for climate information demonstrates the zeal of most households to struggling live with climate change and its effects.

The identified challenges are similar to findings by studies on Kenya's Climate Preparedness, ASAL household adaptation and Household Response to drought in Tharaka in the years 2010, 2011 and 2008 respectively (Mutimba et al 2010; Bryan et al, 2009; Smucker et al, 2008).

4.5 Results from Focus Group Discussions

Focus Group Discussions (FDGs) involving a total of 33 community leaders (11 Badasa , 12 Dirib, 10 Boru Haro) were done in all the sampled sub-locations. The aim was to supplement household information as well as collect community level adaptation strategies. Results obtained highly corroborate household findings. The discussants, for instance, agreed noticing climate variability. "*We have not only noticed rainfall changes but suffered effects of prevalent rain failure and droughts in the past 20 years'* observed Mzee Guracha Mega from Dirib Gombo sub-location. Key changes identified include increase in temperature and changes in rainfall amount, frequency of failure and disrupted seasonal patterns. Similar to responses from household interviews, these changes were mainly attributed to natural causes, destruction of indigenous forest and divine punishment to local population for forsaking tradition practises of appeasing rain gods and ancestral spirits.

The discussants were also able to link the changes to their livelihoods and point out some key adverse effects arising from climate changes. These are: repeated crop failure and poor yield, dwindling livestock numbers, increased households poverty and social ills (e.g. cattle rustling, poaching and prostitution), prevalent water shortage and disappearance of livestock forage. However, they were clear that climate variability was not a new phenomenon but its scale and severity has increased beyond community and households' internal capacity to handle in the recent past.

Though climate adaptation strategies were identified, most of these strategies were noted to be reactive largely triggered by unusual climate phenomena.

Among the key ccommunity level strategies identified are: soil conservation measures (digging farm trenches) in Badassa, planting of tree nurseries in Dirimb Gombo, emergency of village group saving and merry-go rounds, digging and protection of shallow wells in Badassa sub-locations, sinking of community boreholes and excavation of earth dam in Dirimb Gombo.

Though the discussants agreed that the effects of climate variability were fairly well managed in the past 15 years, the ability of most households to cope with future effects was doubted.

Further, it was observed that the effects of climate change have compelled and will continue to compel an increasing number of agropastoralists to give up their traditional livelihood activities and pursue other response measures in the division. At the time of the study, most household reportedly rely on support from agencies. Among the agencies mentioned to have provided or continue to provide critical supports in the past 15 years are: World Food Program, CARE International, Kenya Women Trust Fund and Arid Land Resource Management Projects (ALRMP). However, while they agreed that these agencies have generally met its short-term objective –to save lives and avert crisis- their interventions lacked long-term measures to address underlying causes of vulnerability. On the reverse side, intervention like large-scale food distribution was criticized as having created some level of dependency among the community. An elder, for instance, observed during the interview *"Despite the good rains, people don't grow food crops as before. They think relief foods will always be available"*

It was also observed that over the past 15-20 years, most households have diversified their livelihoods to expand their income portfolio. Main strategies used include switch to off-farm incomes (wage employment or sale of environmental resources etc), change in stock compositions to more drought-resistant species e.g. goats, camels and chicken) and engaging in home gardening.

In addition, supports options that would help mitigate future effects of climatic variability were indentified. This are: promotion of small-scale irrigation, support to small-scale trader, agro-forestry farming, and enhanced livestock and crop insurance premium, increased rain water harvesting and development of Early Warning System (EWS).

Finally, poverty and diminishing traditional social support network were noted as key challenges in hampering both current and desired strategies. Indeed, drought has blurred social boundaries between wealthy and poor in terms of livestock ownership. One of the participants succinctly captured this. *"When drought takes your livestock, your clans restock you or loan you with mature female cow(s). Unfortunately everyone is the same now. Drought have equalized us and we are all orphan" observed Elder Boru*

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of Major Findings

The study revealed that an overwhelming majority of respondents have noticed climate variability. Indeed, most respondents were able to define their climatic surrounding albeit subjectively as well as link climate variability to their livelihood strategies. It also found that changes in rainfall (amounts, spacing, seasonality, onset and cessation) and temperature, the two key production parameters for agriculture, pose a great challenge to local people's livelihood to a significant extent. Key effects of climate variability identified over the last 15 years in the division include repeated crop failure, reduced and/or loss of livestock holdings, increased households' poverty, severe water shortage, and diminishing forage species. In term of frequency of impacts, water shortage, increase reliance on food aid, decline in crop and livestock produce and loss of or decrease in livestock holdings were most frequently noticed. In addition, most respondents anticipate that the trend of climate variability and its impacts will worsen in future with many blaming destruction of natural forest as the cause of variability. Some, however, attribute the perceived changes to divine anger (God's annoyance) and/or curse from ancestral spirits.

In responses to effects of these changes, most households have diversified their income sources through many innovations both at households and farm levels over the past 15 years preceding the study. Some of these innovations are not just potentially scalable but also gives immense insights into the direction of future local adaptation strategies. Changes in crop farming and animal husbandry practices over the years (since 1998) were commonly practiced by households. However, though climate variability was identified as a key contributor, environmental factors like decreased in soil fertility and other social factors was noted to accelerate these changes.

Other measures practiced to a great extent include changes in crop types from traditional staple crops to commercial ones, adjustment in planting time, saving of household assets for lean period, farm crops diversification, reliance on food aid and other external supports and engaging in non-farm activities e.g. casual labor, bee keeping and sell of forest related products.

The study found four commonly adopted livelihood changes/responses households in the last 15 years in the division. These include livelihoods diversification to off-farm incomes (wage employment or sale of environmental resources and small trade), change of stock to drought-resistant livestock goats, camels and indigenous chickens, adoption of pre-impacts saving of assets and incomes as well as kitchen gardening practices. Despite many responses strategies, most households were not optimistic on continued success of these responses in future. In fact, Focused Groups Discussion (FGDs) discussants attribute the successes realized in adaption strategies so far to supports provided by development partners than outcome of successful household adaptation. Though not explicitly focused on climate adaptation, it was observed that these supports have somewhat cushioned poor households from adverse effect of climate variability.

In exploring desired livelihoods options to mitigate effects of future climatic variability, the study found that most households prefer to invest in small scale irrigation, diversify to non-farm incomes sources as well as engage in small-scale trade. Stock diversification to goats, and camel, adopting agro-forestry and tree farming, investing in livestock insurance premium and domestic water harvesting were also some of the options preferred by significant percent of households.

Finally, the study revealed that both current and future strategies are challenged by poverty and lack of capital, climate uncertainty and lack of reliable climate information as well as inadequate knowledge on other livelihoods options. Therefore, most respondents were skeptical of their continued ability to manage growing effects of climate variability without external supports.

5.2 Conclusion

The level of perception on climate variability and its impacts was high with repeated crop failure, reduced and/or loss of livestock holdings, increased households' poverty and rampant water shortage as the main impacts indentified. The combined effects of climate unpredictability and lack of climate information at the local level was found to accelerate livelihood vulnerability to continued climatic shocks. There is therefore need for building information-based responses to climate change impacts.

Though most households have adjusted their crops farming and animal husbandry practices in response to climate variability effects, direct nature-based livelihoods (livestock tending and crop cultivation) were reduced and alternative non-farm activities (casual and wage employment, sale of wood products and trade) increased.

While this study provide insights to what local population prefer in adapting to climate variability and indicate their strong intention to ameliorate adverse impacts of climate change, these strategies are both inadequate and ineffective in light of increasing effects of future variability. There is therefore need for concerted efforts to build not only on adopted household adaptation strategies but also help them reduce current vulnerability as well as build future resilience. The pursued livelihood enhancement measures should reflect people's preference both within and outside agro-pastoralist livelihood portfolio.

5.3 Recommendations

Based on the research objectives and above findings, the following recommendations were made:

> While this study revealed great sense of climate awareness, there is need to engage communities to understand their levels of vulnerability and design their own sustainable adaptation action plans.

This can be done through adoption Community Managed Disaster Risk Reduction (CMDRR) model which among other measures involve capacity building of community members and development partners to participate in and help local people adapt their livelihood strategies accordingly.

Invest in generating and providing demand-driven and client-oriented climate information to enable households to make informed decisions (e.g. better farm and household level adjustment) and potentially minimize economic effects of climate variability. This should be accompanied by disseminating the information in a form understandable to local users in addition to providing relevant extension services to households e.g. services on adaptation-related crop productions, livestock and viable households' level strategies.

Initiate focused measures that would strengthen and rehabilitate current livelihood strategies and household assets to build future resilience. There is need for focused support from development partners and government to help in adaption initiatives. With remarks that assistance from some agencies are contributing to dependency, there is need to adopt a mix of climate adaptation and development approaches as well as focus on strengthening existing and diversified innovations at household level. This should also involve discouraging unsustainable and environmentally destructive income-earning activities such as harvesting trees for firewood, timber and charcoal burning pursued by some poor households.

There is need to address underlying causes of household vulnerability to climate variability and changes which poses key challenges to both current and desired livelihood strategies. Increase access to climate information and financial services, increase levels of literacy and overall improvement in infrastructure would help in building future adaptive capacities as well as enhance climate-resilient livelihoods in the division.

Other key adaptations constrains include ethnic conflicts manly over water and pastures resources hence need for strengthening conflict resolution and management mechanisms.

Mainstream climate change in plans, programs and projects through working with policy makers, development agencies, research institutions, County government and the media at various levels. Government and development agency staff should, for instance, be trained on mainstreaming climate adaptation in program design with focus on helping local people adapt their livelihood strategies accordingly.

Improve access to water infrastructure. Given that water shortage was cited as the main negative effects of climate variability in the division, this will be a critical intervention. This will open up available adaptation avenues to the local population and thereby result to livelihoods resilience.

5.4 Suggested Areas of Further studies

This study focused on understanding local perceptions on climate variability but did not quantity climate variability impacts in financial or agricultural terms. It would therefore be enriching to understand quantitative impacts of climate variability against the meteorological data. The study also indentified key adaptation challenges in the division which require an in-depth analysis of societal and biophysical barriers to fully understand and address them. In addition, it also focused on indentifying response strategies but not the variables that often influence or determine households' decision to diversify. This too requires further academic inquiry.

REFERENCES

Assan, J.K., Caminade C., Obeng F. (2009). Environmental Variability and Vulnerable Livelihoods: Minimising Risks and Optimising Opportunities for Poverty Alleviation. *Journal of International Development,* 21:403–418.

Batisani, N. & Yarnal, B. (2010).Rainfall variability and trends in semi-arid Botswana: Implications for climate change adaptation policy. *Journal of Applied Geography,* 30:483–489.

Brown, O., & Crawford A. (2008).*Assessing the security implication of climate change for West Africa.* IISD, Winnipeg, Manitoba.

Bryan, E., Ringler C.,Okoba B., Roncolio C., Silvetrin, S., & Herrero, M.(2011). *Adapting Agriculture to Climate Change: Households and Community Strategies and Determinants.* World Bank.

Cooper, M., Dime, R., Shapiro, B. & Twomlow, S. (2008).Coping better with current climatic variability in the rain-fed farming systems of sub-Saharan Africa: An essential first step in adapting to future climate change? *Journal of Agriculture, Ecosystems and Environment,* 126: 24–35.

Deressa, T., Hassan,R.M. & Ringler, C.(2008).Measuring Ethiopian Farmers' Vulnerability to Climate Change across Regional States. *International Food Policy Institute.* Washington, DC Retrieved from http://www.ifpri.org/sites/default/files/pubs/pubs/ib/rb15/rb15_05.pdf

Ellis, F. (2000).*Rural Livelihoods and Diversity in Developing Countries.* Oxford University press, USA: New York.

Eriksen, S., Brown, K & Kelly, M. (2005). The dynamics of vulnerability: locating coping strategies in Kenya and Tanzania. *The Geographical Journal,171(4):* 287–305.

GOK (2010). *National Climate Response Strategy*; Ministry of Environment and Mineral Resource Development; Nairobi, Kenya.

IPCC (2007). *Climate Change Impacts, adaptation and vulnerability.* Contribution of Working Group II to the Fourth Assessment Report of IPCC. Cambridge. UK. Cambridge University Press

Kenya National Bureau of Statistics (2010). Kenya population and housing Census: Population distribution by administrative units. Volume IA.

Lioubimtseva, E., & Henebry G.M.(2009). Climate and environmental change in arid Central Asia: Impacts, vulnerability, and adaptations. *Journal of Arid Environments,* 73: 963–977.

Little, P. ,Mahmoud H., Layne D., Coppock, D.L.(2001). When deserts flood: risk management and climatic processes among East African pastoralists. *Journal of Climate Research, 9*: 149–159.

Mariara, J.K. (2009). Global warming and livestock husbandry in Kenya: Impacts and adaptations. *Journal of Ecological Economics*, 68: 1915–1924.

Mutimba, S., Mayieko, S., Olum, P. & Wanyatma, K. (2010).Climate Change Vulnerability and Adaptation Preparedness in Kenya. Heinrich Böll Foundation. Nairobi, Kenya.

Mugenda, O. & Mugenda, A. (2003).*Research Methods. Quantitative and qualitative approaches.* Nairobi; Acts Press.

Obando, H., Otieno, W., Macharia, A., Ensord, J., Tumuising, W., Kisianganid, E., Muchirid, L. & Amolloe, N. (2009).*Reducing vulnerability of Pastoralists communities to climate change and variability in Northern Kenya. Climate and Sustainable Development.* International Conference Theme 2.Retrieved on 15th May 2012.

Poortinga, W., Spence A., Whitmarsh, L., Capstick, S., & Pidgeon, N. (2011).*Uncertain climate: An investigation into public skepticism about anthropogenic climate change.* Global Environmental Change.GEC: 867.Retrieved from www.elsevier.com/locate/gloenvcha on 24/05/2012.

Saku District development plan (2008). District Development Plan, 2008-2012, Government Printer, Nairobi.

Smucker, A.T & Wisner B. (2008). *Changing household responses to drought in Tharaka, Kenya: vulnerability, persistence and challenge.* Overseas Development Institute. doi:10.1111/j. 190 0361-3666.2007.01035.x. Retrieved from Blackwell Publishing on 25/08/2012.

Smith, J., Roger, L. & Dorothy, H. (2012). Social Capital, Place Meanings, and Perceived Resilience to Climate Change. *Journal of Rural Sociology,* 77(**3**):380–407.

Appendix I: Questionnaire

I am in a final student year at Kenyatta University in the School of Environmental Studies pursuing Masters of Environmental Studies (*Climate Change and Sustainability*). As part of my course requirement, I'm undertaking a research project titled "**CLIMATE VARIABILITY AND RESPONSE STRATEGIES AMONG THE GADAMOJI AGRO-PASTORALISTS OF MARSABIT COUNTY, KENYA**". In this regard, I'm kindly requesting for your support by responding to below questionnaire. Your accurate and candid response will highly be appreciated.

General Information

1. Please indicate your gender Male [ ] Female [ ]

2. Tel Number..... Location..... Village.....

3. How old are you? Below 25 years [ ] 25 to 35 years [ ] 35 to 45 years[ ] 45 to 55 years [ ] Above 55 years [

4. For how long have you been practising agro-pastoral farming.....?

5. What is your current main income generating activity? Sale from crop produce [ ] Livestock keeping [ ] Formal employment [ ] Bee keeping [ ] Business [ ] Wage employment [ ] *Khat* sale [ ] Crafts work [ ] others (please specify) [.....]

A. Perception on climate variability and impacts livelihoods

6. Have you noticed any change in the average temperature and rainfall over the last 15 years (from 1998)? Yes ☐ No ☐

7. If yes, how do you describe these changes? (*please tick appropriate responses)*

i. Rainfall amounts: Increased, Decreased, Same, Fluctuated

ii. Rainfall spacing: Widened, Narrow, Same, Cannot Tell

iii. Rainfall time (season): Shortened, Extended, Same, Cannot Tell

iv. Rain onset and cessation: Delay onset & ends early, early onset & ends late

v. Frequent rain failure

vi. Temperature; Increased, decreased, same, cannot tell

8. Of the above rainfall variability aspects, which ones pose great challenges to your livelihoods and why?

……

To what extent does climate variability affect your main sources of households' income?

To a very great extent [ ] To a great extent [ ] To a moderate extent [ ] To a low extent [ ]

9. How does climate variability affect your livelihood strategies in the last 15 years?

……

10. To what extent have you been facing the following conditions since 1998 in terms of frequency due to climate variability?

Effects	**Very great extent**	**Great extent**	**Moderate extent**	**Low extent**	**No extent at all**
Drought phenomena					
Change in weather pattern					
Severe water shortage					
Vegetation/pasture degradation					
Loss of livestock or declining number					
Food insecurity					
Increase reliance on food aid					
Repeated crop failure					
Household in/out migration					
Declining crop and livestock production					
Increase crop and livestock diseases					

11. In your opinion, what is the cause of climate variability in Gadamoji division?
Natural Causes [ ] Destruction of nature by man [ ] God's Annoyance
[ ] Others (e.g. Break-down of tradition) [ ]

12. Do you believe climate variability and its impacts on your livelihoods will worsen in future? Yes [ ] No [ ] I don't know [ ]

Section C: Households Livelihoods Responses

13. Have you been changing your crop farming and animal husbandry practices in the last 15 years (since 1998) due to climate variability? Yes [ ] No [ ]

14. If yes, to what extent have you been practicing the following agricultural and household-level adaptation strategies?

Strategies	Very great extent	Great extent	Moderate extent	Low extent	No extent at all
Plant early maturing and drought tolerant seeds					
Change crop type (e.g. from maize to *miraa*)					
Adjust planting time					
Reduce farm size					
Practice soil conservation measures(terracing, manure addition, mulching etc)					
Diversify crops planted					
Diversify herd composition(e.g. rear camel)					
Practice herd splitting and migration					
Slaughter young and old animals					
Reduce herd number (destocking)					
Supplement livestock feeds e.g. feed with tuber					
Fodder preservation e.g. 'kallo'					

Sale livestock meet other basic needs					
Engage in non-farm activities(sale of labour, charcoal and firewood)					
Reliance on food aid and other external supports					
Roof rain water harvesting					
Credits from better-offs, groups and credits institutions					
Adopt during and pre-impacts saving(eat less preferred food, reduce purchase, food reserve)					
Sale milk or crop produces					
Practice kitchen gardening					

18. What two significant livelihood changes/responses have your household made to adapt to effects of climate variability and diversify your income sources since 1998?

……
……

Section E: Livelihoods Intervention Options

19. Have response strategies you identified above (*Refer to question 17*) helped your household adapt effectively to prevailing climatic condition?

Yes [ ] No [ ]

20. What livelihood supports are provided by government or development partners that helped your households manage effects of climate variability in last 15 years? (*List in terms of importance and please state who provided)*

……
……

21. To what extent do you consider the following as the key livelihoods options for your household to minimize effects of future climate variability?

Future adaptation strategies	Very great extent	Great extent	Moderate extent	Low extent	No extent at all
Start small scale irrigation					
Practice agro-forestry and tree farming					
Engage in non-farm income activities(Sale of labor, charcoal, firewood, house building materials etc)					
Start or expand petty trade					
Join or participate in local groups, learn more on credit facilities and entrepreneurship					
Invest in livestock and crop insurance premium					
Intensify domestic water harvesting and storage measures					
Plan based on early warning climate and pasture information					
Adopt conservation measures and seek technical advice on good agronomic practices					
Seek awareness on climate variability and its impacts					
Others(please specify)					

22. What key constraints would you anticipate in managing future effects of climate variability?

……

Appendix II: Interview Guide for Focused Group Discussion

1. Have you noticed any changes in the climatic variable since 1998?

Yes [ ] No [ ]

If yes, what aspect of temperature and rainfall has changed?

2. What do you consider as the main causes of climate variability?

3. What are the key indicators and impacts of climate variability in Gadamoji division?

4. What aspect of climate variability (rainfall and temperature changes) pose great challenges to local livelihoods?

5. How has climate variability affected local livelihood (manly crop farming and livestock rearing) since 1998?

6. What adjustment has households in Gadamoji division made to respond to effects of climate variability on their livelihoods in the period 1998-2012 years?

7. What supports are provided by government or development partners in helping households in Gadamoji division to minimize effects of climate variability at households' and community level in the past 15 years?

8. What livelihood intervention options would enhance local resilience at household and community level to continued effects of climate variability in Gadamoji division?

Appendix III: Map of Gadamoji Division in Marsabit County