ASSESSING ACHIEVEMENTS OF RESILIENT LIVELIHOODS PROGRAMME IN INCREASING COMMUNITY CAPACITY TO RESPOND TO CLIMATE RELATED SHOCKS IN KALAWANI LOCATION, MAKUENI COUNTY, KENYA

BY

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DECLARATION

I declare that this research is my original work and has not been presented by any individual for the award of certificate, diploma or degree in any other institution.

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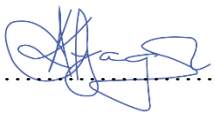
Signature…… 

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DEDICATION

To my beloved wife, the late Carol: your magnanimity and contribution in our collective responsibility of taking care of our sons and standing in the gap for me during the study period deserves special mention. You gave gallantly to the family and those whom you served as a teacher. Your demise remains a difficult eventuality we have to endure as a family but forever melodies of your virtue of hard work lingers on.

ABSTRACT

Climate change is creating vulnerability in communities living in Arid and semiarid lands the world over. It is threatening lives of millions of people in the Arid and semi-arid lands of Kenya. This necessitated humanitarian responses over the years albeit not increasing the resilience of affected communities. As resilience programming gains more and more prominence as an approach for addressing chronic vulnerability of populations exposed to recurrent shocks and stresses, empirical evidence will be needed upon which to base interventions and programmes designed to strengthen their capacity. The purpose of this study was therefore to find out how resilience livelihoods (RELI) programme increased the community's capacity to respond to climate related shocks/stresses in Kalawani Location of Makueni County. The study was premised on resilience theory which conceptualized that households and community wellbeing is dependent on climate shocks/ stresses impacting on them resulting to resilience or vulnerability. The main objective of the study was to assess the achievements of RELI Programme in Kalawani Location in increasing the community's capacity to respond to climate related shocks and stresses. The specific objectives were to: Examine how climate related shocks and stresses contribute to making residents more vulnerable; establish how RELI programme interventions contributed to increasing the community's response capacity to climate related shocks/stresses, and establish challenges inhibiting households from developing resilience to climate related risks. A cross sectional research design was used and using Fischer's formula, a sample of 220 households drawn from a population of 512 household who were beneficiaries of the project. Multistage sampling was applied, and the data obtained triangulated through 6 Focused Group Discussions and 13 Key Informant Interviews among identified stakeholders. The data was analyzed using descriptive statistics. The study established that drought was the major climate related shock. It manifested in increasingly higher temperatures and reducing rainfall that led to an increase in crop pest and livestock disease making agriculture a risky undertaking yet 80.9% of the respondents derived their livelihood from it. It also established that project interventions addressing drought had an adoption rate of 58% which is above average and this can be used as a proxy indicator for improvement capacity to respond to drought. The project brought Financial services to the community through VSLA and expanded their financial base through diversification which was adopted by 60% of the respondents thus addressing the what the community cited as the greatest challenge inhibiting them from developing resilience. The study concludes that the RELI project was able to increase the community's capacity to climate related shocks and put it in the right trajectory for realizing resilience. To avoid relapse to the vulnerability pathway, concerted efforts to overcome the inhibitors to resilience building should be intensified.

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LIST OF ACRONYMS

ASAL	-	Arid and Semi-Arid Land
CSO	-	Civil Society Organization
EWS	-	Early Warning System
FEWSNET	-	Famine Early Warning Network
GOK	-	Government of Kenya
IASC	-	Inter-Agency Standing Committee on Humanitarian Assistance
IDS	-	Institute of Development Studies
IFPRI	-	International Food Policy Research Institute
IPCC	-	Intergovernmental Panel on Climate Change
LDC	-	Least Developed Countries
SDG	-	Sustainable Development Goals
NGO	-	Non-Government Organization
KES	-	Kenya Shillings
KNBS	-	Kenya National Bureau of Statistics
KNCCAP	-	Kenya National Climate Change Adaptation Plan
KFSSWG	-	Kenya Food Security Steering Working Group
NCCAP	-	National Climate Change Action Plan
PVCA	-	Participatory Vulnerability Capacity Assessment
REGLAP	-	Regional Learning and Advocacy Programme
RELI	-	Resilient Livelihoods Programme
SPSS	-	Statistical Package for Social Sciences
UNDP	-	United Nations Development Programme
UNEP	-	United Nations Environment Programme
UNOCHA	-	United Nations Office for Coordination of Humanitarian Affairs
USAID	-	United States Agency for International Development
UNSDR	-	United Nations Strategy for Disaster Reduction
USD	-	United States Dollar

OPERATIONAL DEFINITION OF TERMS

Adaptation: Adjustments to the natural or human system in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities

Capacity: Enhancing the ability of households to respond promptly and effectively to the effects of climate shocks/stresses through the adoption of novel management practices and innovative technologies

Climate: The average weather at a given point and time of year, over a long period.

Hazard: A dangerous phenomenon, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

Participation: The involvement of stakeholders in the design, implementation, control development initiatives and decisions and resources that affect them.

Resilience: Ability of people and systems to absorb shock and building back faster and efficiently maintaining their well-being.

Risk: The probability of harmful consequences or expected loss resulting from interaction between natural and human induced hazards and vulnerable/capable conditions.

Shocks/Stresses: External deviations from long term weather trends, deviations that have substantial negative effects on well -being, level of assets and livelihoods.

Vulnerability: Degree to which a system is susceptible to, and unable to cope with adverse effects of climate change including climate variability and extremes.

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CHAPTER ONE

INTRODUCTION

1.1 Background to the study

Intergovernmental Panel on Climate Change (IPCC) 2018 predicts that humans will become increasingly more vulnerable to climate changes than ever before, without any additional climate-resilient measures, across developing countries in the Tropics. Africa has been identified as one of the parts of the world most vulnerable to the impacts of climate shocks (IPCC, 2014). In the dry lands of East and the Horn of Africa, communities are faced with climate change driven increased repeated episodes of droughts and disasters which make them vulnerable (Gebremedhin, et al., 2019). In the past two decades the region has continued to face rising vulnerability to climate shocks/stresses (Nitya, 2019).

Climate change is causing rise in average global temperatures and sea levels (IPCC, 2014). This is triggering major environmental and economic disruptions which is a major cause of vulnerability. In Kenya, heat, drought, and floods are negatively impacting lives, with human health increasingly being at risk. Extreme climate events cause significant loss of life, and adversely affect the national economy. In the 1997-2016 period, the country experienced an average of 57.95 deaths per year, and GDP losses of 0.362% per year, due to extreme climate events (Eckstein, et al. 2017). The Kenyan economy is dependent on climate-sensitive sectors, such as agriculture, water, energy, tourism, wildlife, and health, whose vulnerability is increased by climate change (GOK, 2018). From a geographical perspective, Kenya's ASALs are particularly vulnerable to the impacts of climate change (Reliefweb, 2018). The ASAL economy is highly dependent on climate sensitive activities, yet it supports more than 70% of the national livestock population, and 90% of wildlife that is the backbone of the country's

tourism sector (County Government of Isiolo, 2014). Floods have caused huge disruptions to human lives in Kenya. The floods experienced in early 2018 claimed over 183 lives, displaced more than 225,000 people, including over 145,000 children, and led to closure of over 700 schools (Kenya Meteorological Department, 2018). The floods were associated with cholera outbreaks in at least five Counties, and people experiencing upsurges in mosquito borne diseases, such as malaria, and dengu fever (Reliefweb, 2018). Between 1990 and 2015, a total of 43 flood disasters happened in Kenya. This is equivalent to an average of 1.65 flood disasters per year. On average, each flood disaster affected 68,000 people (Emergency Events Database, 2015). Estimates show that 267,000 Kenyans will be at risk from coastal flooding by 2030, because of climate change induced sea level rise (Standard Digital, 2014). Cross-border and cross-County conflicts could be exacerbated by climate change. Furthermore, as temperatures rise and rainfall patterns change, some areas become less conducive for livestock, particularly cattle, which leads to reductions in herd numbers. Some Counties which have favourable weather conditions and border the pastoralists areas could enter into resource-use conflicts when pastoralists move their animals to them in search of water and better conditions of pasture (GOK, 2018). Cross border conflicts could increase with neighbouring Countries, such as Ethiopia, and Tanzania, when pastoralists compete for food, water, and grazing lands.

Droughts are large-scale climate shocks in Kenya. The International Disaster Database reported that a total of ten droughts occurred in Kenya between 1990 and 2015. This translates to one drought disaster every two and a half years. An assessment conducted by the Kenya Food Security Steering Group on the 2017 long rain season in Kenya's ASAL Counties found that spatial and temporal distribution of rain was poor across the entire country (GOK,2017). The assessment also established that rains began late in most parts of the country, resulting in a shortened rainy season (GOK,2017). Most areas were reported to have received 50-90% of normal rainfall (GOK,2017). Desertification in ASALs is also a major environmental impact

attributable to climate change, besides human activities. It is intensifying and spreading, and reducing the productivity of land, which negatively affects communities (Mwenda, et al, 2016). Climate change is also a major contributor to land degradation, which encompasses changes in the chemical, physical and biological properties of the soil. Climate change is contributing to the loss of Kenya's biodiversity. The Inter-Governmental Science-Policy Platform on Biodiversity and Ecosystem Services reported that climate change could result in significant losses of many African plant species, some animal species, and decline in the productivity of fisheries in Africa's inland waters during the 21st century (Archer, et al., 2018). Dozens of animals died in 2017 as a result of lack of water and pasture in national parks and reserves; a direct impact of drought. Other climate-related environmental shocks in Kenya include, landslides, and forest fires. Landslides are associated with heavy rainfall in regions with steep slopes, such as Murang'a County, Counties in Western Kenya, and the North Rift Valley (UNDP, n.d.).

The economic cost of floods and droughts in Kenya is estimated to create a long-term fiscal liability equivalent to between 2% and 2.8% of the country's GDP every year (Kenya Institute of Public Policy Research, 2018)). Specifically, the costs of floods are estimated to be about 5.5% of GDP every seven years, while droughts account for 8% of GDP every five years (GOK,2018). The economic impacts of floods are severe; in 2018, rain and flooding wiped out resources worth billions of shillings. Roads and infrastructure were damaged, seasonal crops across an estimated 8,500 hectares of land destroyed, and over 20,000 livestock drowned. The Government allocated over KES 75 billion to combat floods and fix the roads destroyed by the rains (GOK, 2018). The El Niño-induced floods in 1997/1998 caused losses and damages of between US$ 800 million and US$ 1.2 billion in Kenya (Stockholm Environment Institute, 2009). Droughts have had the greatest climate change related economic impacts in Kenya. On average, a 0.6 percentage point decline in GDP growth is observed in years of poor rains

(GOK,2018). This is because most of the country's growth sectors are climate sensitive. The agriculture sector, for example, grew by a mere 1.6% in 2017, compared to 4.7% in 2016. This is because drought suppressed production of crops, and adversely affected livestock production (Kenya National Bureau of Statistics ,2018). From 2007 to 2017, losses in livestock populations due to drought-related causes amounted to about US$ 1.08 billion (World Bank, 2018). It has been established that climate related shocks and stresses make communities vulnerability (economically, socially, and ecologically). There is a wide range of climate related shocks and stresses and it is not known which ones make the community vulnerable in Kalawani and how. This study will examine the climate related shocks /stresses prevalent in Kalawani Location to establish how they contribute to making the community vulnerable?

Against this backdrop of wide-ranging impacts of climate change the government of Kenya and its development partners have acted to reduce climate change related vulnerabilities, and build adaptative capacity and resilience (GOK, 2016). At the National level, many actions in National Adaptation Plan (NAP) *2015-2030* were undertaken through the National Drought Management Authority (NDMA), including initiatives in Arid Semi and Arid Lands (ASALs) aimed at helping the most vulnerable in times of drought (GOK, 2018). Coping strategies of the poorest people in Turkana, Wajir, Mandera, Marsabit, and other ASAL Counties were enhanced through provision of support during droughts. Adaptation actions supported by development partners were on adaptation within the agriculture sector, including irrigation projects, enhancing the climate resilience of pastoralists, and sustainable land management. At county level, many County Governments integrated climate change in their 2013-2017 County Integrated Development Plans (CIDPs); acknowledging that climate change poses threats to their sustainable development (Murphy, & Chirchir, 2017). Garissa, Kitui, Makueni, Isiolo and Wajir County Governments passed regulations to establish County Climate Change Funds (GOK, 2018). The County Climate Change Fund (CCCF) legislations in the few Counties

helped to establish institutional structures to mainstream climate change in plans and programmes. The private sector has been an active partner in the implementation of adaptation-related actions (GOK,2018). It provided technologies, insurance products, and climate information services; many of which are facilitated by smart-phone applications. Various companies have also been active in building the climate resilience of farmers in their supply chains. Adaptation action at community levels has been supported through the Integrated Programme to Build Resilience to Climate Change and Adaptive Capacity of Vulnerable Communities in Kenya, which was supported by the United Nations Framework Convention on Climate Change (UNFCCC) Adaptation Fund, and implemented by the National Environment Management Authority (NEMA) in its role as the National Implementing Entity (NIE) to the Adaptation Fund (GOK,2018). The initiative focused on food security, water management, coastal ecosystem management, and environmental management.

In the past few years' resilience has become quite a buzzword in the aid community (Lovell E, et al., 2019). Discussions on adapting to the changing climate are increasingly peppered with 'need to build the resilience' of people, communities' infrastructure and governments in the face of shocks such as droughts, flooding and rising sea levels. This will reduce exposure and vulnerability of the country, especially poor and vulnerable communities and households to climate shocks. The actions will result to increased number of households with improved ability to cope with climate shocks/stresses through implementation of adaptation actions. Climate Change shocks/stresses are posing challenge to agro-pastoralism sector which is heavily relied on for food and income among the communities in Makueni County. Consequently, now than ever before spurring development with resilience lens factoring in the possibility of external shocks or unexpected development is critical in Makueni County which is classified as ASAL. The well-being of communities living at risk of climate shocks/stresses especially in the ASALs depends on enhancing resilience that provides a critical point of

integration for adaptation strategies. Building resilience is about smart actions taken now so that the impact of inevitable shocks and stresses are minimized and rebound accelerated. Taking a resilience-building approach is critical, because the impact of climate change will go far beyond extreme weather events and dramatic shifts in human development. Additionally, there are more subtle, continuous stresses that will have ripple effects that degrade ecosystems and their vital service flows, impact regional food and water supplies, create health crises, disable infrastructure and even contribute to political and economic instability. The negative impacts of climate change are national with dire consequences for rural communities especially those living in ASALs (GOK, 2018). The increasing realization that people are unable to control factors, such as man-made climate change, earthquakes and long running conflicts has forced them to consider this approach. Resilient livelihoods enable people to anticipate, organise for and adapt to change –good or bad, sudden or slow (Christian Aid, 2016).

Christian Aid implemented Resilient Livelihoods (RELI) programme between 2011 and 2017, to promote diverse adaptation actions that enhance resilience to climate change shocks/stresses. It is known that the RELI project was expected to make the community more resilient to the climate related shocks. What is not known is if the community actually did become more resilient and if they did, then in what ways did the interventions increase the community capacity to respond to climate related shocks and stresses? This study will examine the project interventions to establish how they contributed to increasing the community's capacity to respond to climate related shocks/stresses in Kalawani Location?

Resilience programmes like RELI play a critical role in boosting the adaptive capacity of vulnerable households by providing incentives to adapt. Although many people intuitively link resilient livelihoods approach to enhancing capacity to respond to climate change shocks and stresses, little comprehensive empirical evidence exists.

The overarching question of this study therefore is 'how did the achievements of RELI programme increase community capacity (ability) to respond to climate change shocks/stresses in Kalawani Location of Makueni County?

1.2. Problem Statement

It is predicted (IPCC, 2018) that humans will become increasingly more vulnerable to climate changes than ever before, if there will be no climate-resilient measures, across developing countries in the Tropics. Africa has been identified as one of the regions of the world most vulnerable to the impacts of climate shocks (IPCC, 2014). In the dry lands of East Africa communities are faced with climate change driven droughts and disasters which make them vulnerable (Gebremedhin, et al., 2019). The Kenyan economy is dependent on climate-sensitive sectors, such as agriculture, water, energy, tourism, wildlife, and health, whose vulnerability is increased by climate change (GOK, 2018). The economic cost of floods and droughts in Kenya is estimated to create a long-term fiscal liability equivalent to between 2% and 2.8% of the country's GDP every year (Kenya Institute of Public Policy Research, 2018)). Discussions on adapting to the changing climate are increasingly peppered with 'need to build the resilience' of people, communities' infrastructure and governments in the face of shocks such as droughts, flooding and rising sea levels. This will reduce exposure and vulnerability to climate shocks. The actions will result to increased number of households with improved ability to cope with climate shocks/stresses through implementation of adaptation actions The adaptations strategies promoted by RELI programme were expected to improve their capacity/ability to cope with climate related shocks and stresses if adopted making them more resilient.

1.3. Objectives of the study

The Main Objective of the Study

To assess the achievements of RELI Programme in increasing the community's capacity to respond to climate related shocks and stresses in Kalawani Location, Makueni County.

Specific Objectives

1. To examine how climate related shocks and stresses contribute to making the people more vulnerable in Kalawani Location.
2. To analyse how RELI programme achievements contributed to increasing the community's capacity to respond to climate shocks/stresses in Kalawani Location.
3. To identify challenges inhibiting households from developing resilience to climate related risks in Kalawani Location

1.4. Research Questions

1. How do the climate related shocks /stresses prevalent in Kalawani Location contribute to making the community vulnerable?
2. In what ways do the project interventions contribute to increasing the community's capacity to respond to climate related shocks/stresses in Kalawani Location?
3. What are the challenges inhibiting households from developing resilience to climate related risks?

1.5. Justification of the study

The problem of vulnerability to climate change shocks/stresses is largely documented and known at macro-levels of both national and county governments. Social, economic and

environmental impacts of climate change shocks/stresses are enumerated with requisite resilience policy frameworks established to address the identified vulnerabilities. However, there exists a gap in linking national/county and community resilience actions in relation to existing and evolving climate related vulnerabilities at micro-levels. It is against this backdrop the study was conducted to help bridge the gap between national/county and community resilience actions by seeking to investigate climate change related vulnerabilities in the context of Kalawani Location of Makueni County on how RELI programme had contributed to increasing community resilience. Makueni County government was the first County in Kenya to legislate on climate change subsequently establishing institutional frameworks to address climate change, thus providing an enabling environment in interrogating the link between national/county and community resilience actions. At the time of the study through a consultative process, the leadership in Makueni county identified Kalawani Location as a model area in the implementation of community resilience actions. The study therefore set out to assess the achievement of RELI programme with aim of generating learning to contribute to understanding of contested subject of context specificity of resilience in the face of increased frequency and intensity of climate shocks/stresses.

1.6. Scope and limitations of the Study

The study covered the activities of RELI Programme in Kalawani Location of Tulimani Division, Makueni County. The programme was funded by Department for International Development (DFID) of the United Kingdom (UK) through Christian Aid an international NGO. Christian Aid through a local partner the Anglican Development Services Eastern (ADSE) implemented RELI Programme in Kalawani Location between 2011 and 2017. The programme implementation involved supporting diverse interventions geared towards strengthening adaptation and resilience to climate change shocks. The study endeavoured to

identify resilience interventions supported by the programme and to what extent they had been adopted by the households and therefore contributed to building resilience in a context of repeated climate change shocks and associated challenges of adopting the interventions.

Some of the resilience interventions in the study area had a spill over effect to neighbouring communities. This was particularly true for investments on public common goods like water pans. While the study endeavoured to assess achievement of the Resilience Livelihoods Programme within Kalawani Location as the targeted study area it didn't extend to capture the views of beneficiary households from neighbouring communities. To key informant respondents were asked to provide information on wider impact of the project beyond the study area owing to their overarching mandate to mitigate on the absence of views of RELI programme beneficiaries outside of Kalawani Location.

CHAPTER TWO

LITERATURE REVIEW

2.1. Introduction: Overview of the Chapter

This chapter delves to provide and review some of the available literature relating to climate change, resilience and vulnerability. The chapter looks at the theoretical foundation, the underpinning evidence why climate change is an important development issue of our generation and efforts made towards responding to its shocks and stresses. A summary of the conceptual framework showing the relationship between the study objectives and the key variables is also given.

2.2. Climate Related Shocks and Stresses

Climate change is a global problem that demands a global solution, and Kenya is an active player in international efforts. The international response to climate change is founded on the UNFCCC that entered into force in 1994 (GOK,2018). Kenya signed the UNFCCC on 12th June 1992 and ratified the Convention on 30th August 1994. The country is a key player in the global climate change governance system and participates in meetings of the Conference of the Parties (COP) to the UNFCCC, articulating the national interest, and the country's position, during international negotiations**.** Paris Agreement linked to UNFCCC entered into force internationally in 2016. The Paris Agreement aims at strengthening the global response to the threat of climate change, by keeping rise in global temperature during this century to well below 2 °C above pre-industrial levels. Additionally, the Agreement aims at strengthening the ability of countries to deal with the impacts of climate change.

A robust framework of policies, plans, and institutions is being progressively established at the National and County levels in Kenya to address climate change (GOK,2018). The foundation of the institutional and legal framework for climate change action is the Constitution of Kenya (2010). Article 42 provides for the right to a clean and healthy environment for every Kenyan, which includes the right to have the environment protected for the benefit of present and future generations through legislative and other measures. Climate Change Act, 2016 is the key legislation guiding Kenya's climate change response. It is the legal basis for mainstreaming climate change considerations and actions into sector functions and provides the legal foundation for National Climate Change Actions Plans (NCCAPs). County Governments have a key delivery role in implementing the Climate Change Act, 2016, having jurisdiction, as set out in the Fourth Schedule (Part 2) of the Constitution, over sectors relevant to climate change action, such as agriculture, soil and water conservation, forestry, water and sanitation, tourism, and health. In 2015 Makueni County developed and legislated a County Climate Change Fund Regulation as an appropriate framework for availing financial flows to support climate change actions. In 2020 the County developed environment and climate change policy to coordinate efforts by all its sectors to achieve a positive climate change and sustainable natural resource utilization.Extreme climatic events have long posed a significant risk to regions in Kenya, and they have contributed to making it one of the most disaster-prone countries in the world (AEA Group, 2008). Historically, these extreme climatic events have caused significant loss of life and adversely affected the national economy. Droughts have affected the most people and had the greatest economic impact; it is estimated that droughts cost about 8.0 per cent of GDP every five years (AEA Group, 2008). While usually more localized, floods have led to the greatest loss of human lives (GOK,2018). Other climate-related hazards in Kenya include forest fires and landslides, the latter of which mostly affect the highland regions (UNDP, n.d.).

Climate change is likely to adversely affect many sectors in Kenya (GOK,2018). For instance, there will is high likelihood of decline in overall crop yields in most areas, due to insufficient availability of water, excessive moisture conditions and, more pests, diseases, and greater food insecurity. In the livestock sector, deaths caused by drought, decline in production, due to lack of pasture, reduced access to water, and heat stress. Changes in disease patterns, and potential for re-emergence of climate related diseases and pests impacts on livestock and crops. The frequency and scale of droughts especially in the ASALs is intensifying with resultant effect of food insecure and malnourished people. In the environment sector, there is increased likelihood of contestation and conflicts over diminishing natural resources and increases in invasive species, and new pests and diseases. Increased frequency and intensity of flooding, which could decrease people's ability to cope.

According to the World Health Organization (WHO), 2018 climate change affects the social and environments determinants of health – clean air, safe drinking water, sufficient food and secure shelter. The WHO projects that between 2030 and 2050, climate change is expected to cause approximately 250 000 additional deaths per year, from malnutrition, malaria, diarrhoea and heat stress. The direct damage costs to health (i.e. excluding costs in health-determining sectors such as agriculture and water and sanitation), is estimated to be between USD 2-4 billion/year by 2030.

Further climate change affects energy sector in various ways (GOK,2018). Climate change induced adverse weather conditions of reduced rainfall and increased episodes of prolonged droughts results to decline in forest productivity, which restricts availability of fuelwood, reduction in the capacity for hydroelectric generation, due to decline in water flows in rivers, particularly during dry seasons and, increased reservoir siltation, and increased demand for energy, as high temperatures encourage the use of air conditioners and refrigeration. In the tourism sector climate change is adversely impacting on ecologically sensitive tourist

destinations and influencing Potential for migration of wildlife populations, with implications for park boundaries and human-wildlife conflict. In the water sector climate change has caused reduced availability of surface water for activities, such as irrigation, livestock production, household use, wildlife, industry and increased water loss from reservoirs, due to evaporation.

2.2.1. Climate change variability

Kenya's climate is already changing. The Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) presents strong evidence that surface temperatures across Africa have increased by 0.5 – 2 °C over the past 100 years, and from 1950 onwards, climate change has altered the magnitude and frequency of extreme climate events (Niang, et al.2014). The frequency of cold days, cold nights, and frost has decreased; while the frequency of hot days, hot nights, and heat waves, has increased. Temperature rise has been observed across all seasons in Kenya, but particularly from March to May. Variations exist between locations, with a lower rate of warming observed along the coast (Daron, 2014) The surface temperature trends of Nairobi and its environs show warming of more than 2.5 °C in the past 50 years (Funk, et al., 2012). Rainfall patterns have also changed. The long rain season has become shorter and drier, and the short-rain season has become longer and wetter. Overall annual rainfall remains low, with the long rains declining continuously and, droughts becoming longer, more intense, and tending to continue across rainy seasons. The frequency of rainfall events that because floods has also increased, not just in Kenya, but in the entire East African region, from an average of less than three events per year in 1980s, to over seven events per year in 1990s, and ten events per year from 2000 to 2006. The frequency of droughts and heavy rainfall has also significantly increased in the East Africa region in the last 30-60 years.

Rising annual temperatures are a trend that is expected to continue in Africa in all seasons (Said, et al. 2018). This concurs with the IPCC Fifth Assessment Report, which indicated that

during this century, temperatures in the African continent would rise more quickly than in other land areas, and that this would particularly be observed in more arid regions. Climate modelling for the East Africa region using a high-emissions scenario suggested that mean annual temperatures would increase by 0.9 °C by 2035, 2.2 °C by 2065 and 4.0 °C by 2100 (IPCC,2014).

Kenya's exposure to climate shocks stems from a variety of factors. Kenya is already one of the most water-scarce countries in Africa, and access to water is likely to become further constrained due to population growth, economic expansion, and changes in rainfall patterns. Within the economically important agricultural sector, nearly all crop production in Kenya (98 per cent) is rain-fed (WRI, 2007), and about half of all livestock production occurs in the ecologically and climatically sensitive ASALs (IFAD, 2017). Production capacity at the large hydropower stations that generate over half of Kenya's electricity has fallen in recent years due to drought and poor rains, resulting in annual power shortages (Mutimba, et al., 2010). The country's large tourism industry relies on natural attractions such as wildlife, marine ecosystems and the glaciers of Mount Kenya. This sector, as well as the industrial sector, requires reliable infrastructure such as electricity, roads and water supplies. Malaria, outbreaks of which are highly influenced by changes in temperature and rainfall, is responsible for 5 per cent of all deaths in Kenya annually (Dekens, et al. 2011)), making it the number-one cause of disease and mortality among children and adults (Yanda, et al., 2006). These climate risk factors affect all Kenyans, but disproportionately affect those living in flood- and drought-prone areas and members of poor households, including women, children, the disabled, people living with HIV/AIDS, internally displaced people and international refugees.

Climate change threatens, *inter alia*, alters spatial distribution of infectious and respiratory diseases, increase weather-related mortality, increase the salinity and temperature of oceans (altering fish stocks), modify the supply, demand and quality of freshwater, radically alter crop

yields and the area of arable land, and increase the frequency and severity of natural hazards (IPCC, 2007). It is in this context that the Human Development Report 2007/2008 asserted that climate change is "the defining human development issue of our generation" (UNDP, 2007).On the basis of either the projected impacts of climate change on crop yields, areas of arable land, natural hazards, or sea-level rise, it is evident that the consequences of climate change will be distributed unequally, affecting the poorest countries disproportionately, not least as they are more likely to rely on natural resources and economic sectors that are vulnerable to climate change, such as agriculture, fisheries and forestry. Moreover, climate change is likely to have the greatest negative impact on the poorest sections of populations. Poorest citizens are known to most likely to be found in underserved rural areas; derive most of their income, directly or indirectly from agriculture or natural resources; live in insecure environments and have few assets or entitlements to cope with shocks and stresses. They also have limited political voice and representation; and have little access to decent work opportunities (CPRC, 2008). It is likely that the physical effects of climate change will make these poverty traps more severe and "create a vicious cycle of poverty and vulnerability.

2.2.2. Responding to Climate Change Shocks/stresses

Hindrance to effective implementation of adaptation and resilience interventions. Both National and Sub-National governments must ensure that requisite legal policy frameworks on climate change adaptation are established to support integration of climate change into development planning and budgeting. Experience shows that lack of relevant supportive climate change policy and legal framework hinders coordinated response to climate change shocks which has multi-stakeholder representation (OECD, 2006).

Climate change mainstreaming may have much to learn from political science in focusing attention on incentive structures for individuals, organisations and institutions. These include

early attention to regulatory and bureaucratic issues when considering policy implementation, as well as transaction costs of changing to a different set of practices associated with adaptation (Orindi, & Murray, 2005). The mainstreaming fatigue experienced by many engaged in international development and elsewhere must also be tackled by creating positive and recognisable goals and avoiding replication with other parallel processes (for example, by combining tools for disaster risk reduction and climate change adaptation where possible). Donors can attach specific demands to development finances that do not provide incentives for developing country governments to take particular climate adaptation actions. These should be appropriate to local contexts. Climate adaptation training programmes for representatives of different development sectors can come with monetary or career development assistance and finance accordingly.

Adaptation and resilience building require considerable funding. Current international resources available for adaptation are far much less to meet the enormous needs of vulnerable communities in developing countries (IPCC, 2014). Given the low baseline, developed countries must continue to play a role in assisting developing countries through provision of financial and technical assistance to improve the enabling environments that best facilitate mainstreaming and successful adaptation. Improving understanding of what contributes to such enabling environments, mainstreaming processes and effective adaptation measures will be central to this process. This will require research and tools to monitor the mainstreaming process, building on those available in other areas such as disaster risk reduction. It will also require greater attention to monitoring and evaluation of adaptation, including analysis of the costs and benefits of risk reduction and adaptation measures, to place them within the context of development priorities.

2.4. Theoretical Framework

The study draws from the theoretical framework of resilience thinking (Holling, 1973) and the concept of livelihoods resilience (Tanner, et al. 2014). Walker and Salt (2006) define resilience as the capacity of a system to absorb disturbance and still retain its basic function and structure. Resilience thinking has evolved considerably, even over the past decade. The disaster resilience framework promoted by UK Department for International Development (Oddsdóttir, 2013) involved four elements that described resilience: context, disturbance, capacity to deal with disturbance, and reaction to disturbance. While DFID's framework approached resilience primarily from a disaster risk reduction (DRR) perspective, other approaches had climate change adaptation (Oxfam 2011) and improved livelihoods (Alinovi et. al. 2011). One of the challenges of a DRR-cantered approach was the short funding cycle, which limited the ability of resilience programming to sufficiently promote and improve adaptive capacity or to address longer-term enabling conditions necessary to remove structural causes of vulnerability. A longer-term approach was needed that would combine emergency aid with development programming, would be multisectoral, and would promote synergistic partnerships/alliances between NGOs and other actors. The resilience framework presented by Frankenberger, Spangler, and others (2012) builds on these qualities and integrates livelihoods, DRR, and climate change adaptation approaches into a single framework for assessing resilience. Ultimately, a conceptual framework for resilience assessment can help determine whether households and communities are on a trajectory toward greater vulnerability or greater resilience (Frankenberger, et al. 2012). Since the late 1990s, resilience thinking has gained prominence in international development and policy communities (Berkes, et al. 2002, Jones, & Tanner, 2014, Walsch-Dilley, et al. 2016). Resilience is now a popular policy concept within the climate change adaptation and development context. It has become dominant particularly

in national policy, international development and global environmental change discussions (Adger, et al., 2011)

However, although resilience thinking has been praised by some, it has also attracted criticisms. For example, resilience thinking is often highly context specific, which challenges its implementation within policy (Cooper, & Wheeler,2015), and it is often focused on natural systems, downplaying the importance of the social or political side of social-ecological systems (Brown, 2014). One response to these criticisms has been the development of a livelihood perspective in resilience thinking. Tanner et al. (2014) propose that the lens of resilience "requires greater attention to human livelihoods if it is to address the limits of adaptation strategies and the development needs of the poorest and most vulnerable people." Livelihood resilience is defined as "the capacity of all people across generations to sustain and improve their livelihood opportunities and well-being despite environmental, economic, social, and political disturbances (Tanner et al.2014) "A livelihood approach expands the understanding of resilience to acknowledge that people's circumstances, cultures, values, and perceptions affect their ability to adapt. Building livelihood resilience means that a given household's livelihood strategies are better prepared to manage the effects of shocks, navigate uncertainty, and adapt to changing conditions (Ngigi, et al. 2015).

A common strategy employed in NGO resilience-enhancing programs is to emphasize improving the absorptive, adaptive, and transformative capacity of households, communities, and higher-level systems affected by shocks and stresses (Béné, et al. 2013). Christian Aid's RELI Programme supported strengthening absorptive and adaptive capacities at the household and community levels by promoting initiatives that minimized exposure to shocks and stresses, in essence preserving the stability of livelihood systems. Given the predominance of agriculture as the source of livelihoods in the study area, RELI Programme promoted climate change adaptation.

Resilience has commonly been presented as a positive attribute, as the opposite of vulnerability, and used to understand adaptive capacities to tackle the impacts, shocks and stresses of climate change. During this recent resilience renaissance, the concept has been understood in three broad ways. The first is 'engineering resilience', an idea associated with the property of systems to bounce back to normality (Holling, 1996). In the climate change adaptation setting, this implies the return of the functions of an individual, household, community or ecosystem to 'normal' conditions, with as little damage and disruption as possible following a shock/stress. The second is the 'ecological' view, which draws heavily on socio-ecological systems (SES) theory (Folke, 2006). It is characterized by the inevitability of uncertainty (which may destabilize attempts to manage the capacity of systems to cope with change) and interactions across scales (Bahadur, *et al*., 2013). It emphasizes phases of growth, release, and reorganization within systems, and the way shocks destabilize systems and produce transitions to new systems. The third understanding is as a term that spans disciplinary boundaries, based on the widespread appeal and versatility of resilience as an idea (Brand, & Jax, 2007). As an inclusive term, it offers the potential for more integrated approaches to a range of shocks and stresses, including food security, conflict and disasters (Alexander, 2013).

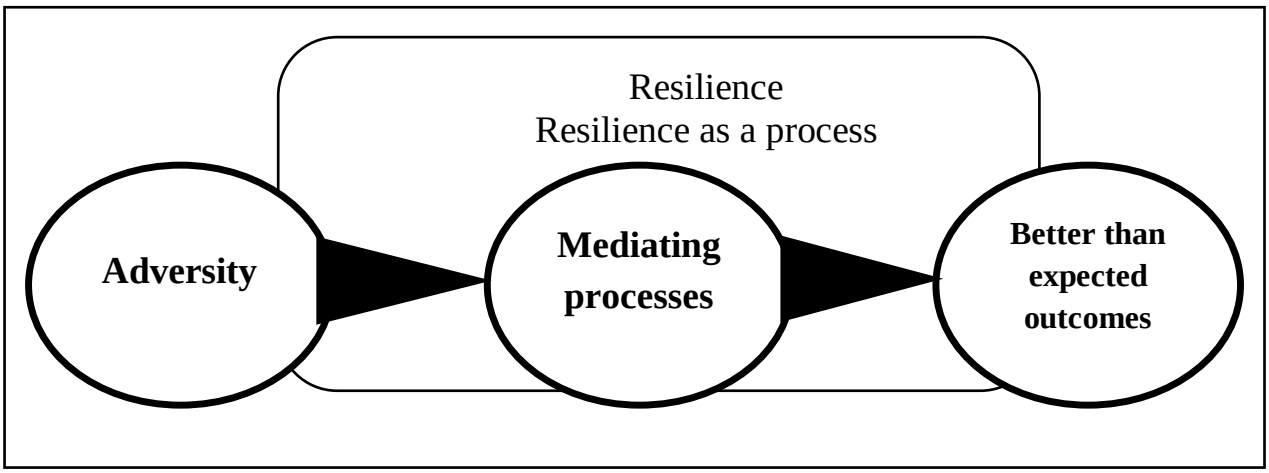

Figure 1: Resilience as process and outcome

Source: Michael 2000

In responding to recent calls for a 'social turn' in resilience thinking (Hinkel, *et al*., 2011), proposed an approach that focuses on people and the constraints and opportunities they face in sustaining livelihoods, as the central actors within adaptation policy and practice. Applying the concept of resilience to climate change adaptation raises some complex challenges. Climate change is not exclusively an environmental problem that can be addressed purely in scientific, managerial or technical ways (Cannon, & Muller, 2010). The process-outcome debate in resilience theory is valid but creates an unnatural split between process and outcome. Resilience research involves three connected components: adversity, outcomes and mediating factors. It is not possible to think about or research resilience without considering all three components. Nevertheless, the problem with the outcome definition of resilience is that it merely declares the observation of positive outcomes in the face of adversity; it does not explain them. A declaration without an explanation has limited use and for this reason the process definition of resilience is to be preferred. Conceptually, then, resilience is a process that leads to an outcome, and the central focus of resilience research is on the mediating processes. Taking cue from this view the study conceptualizes a process definition of resilience in assessing the achievements of the RELI programme in increasing community capacity to respond to climate change shocks/stresses. The framework envisages a context in which the intervening variables of adaptation actions contribute to strengthened resilience to climate change shocks/stresses. The climate change related shocks/stresses manifest in terms of variations in temperature and rainfall driven by both natural causes and human activities. The adaptation actions modify the exposure, sensitivity and capacity in dealing with climate change shocks and associated variations in temperature and rainfall leading to an ultimate outcome of improved livelihoods. In this context, resilience refers to a process encompassing positive adaptation within the context of significant adversity caused by climate change shocks/stresses. To help distinguish between process and outcome (Ungar, 2004) recommended that different

terms be used for them and suggest that 'resilience' is best used as a process definition, and that 'resilient' be reserved for an outcome definition. Thus, one could say that a person or social system is 'resilient' because it evidences good outcomes in the face of adversity. On the other hand, one could say that the 'resilience' of the person or social system is supportive relationships and a hope for the future.

2.5. Conceptual Framework

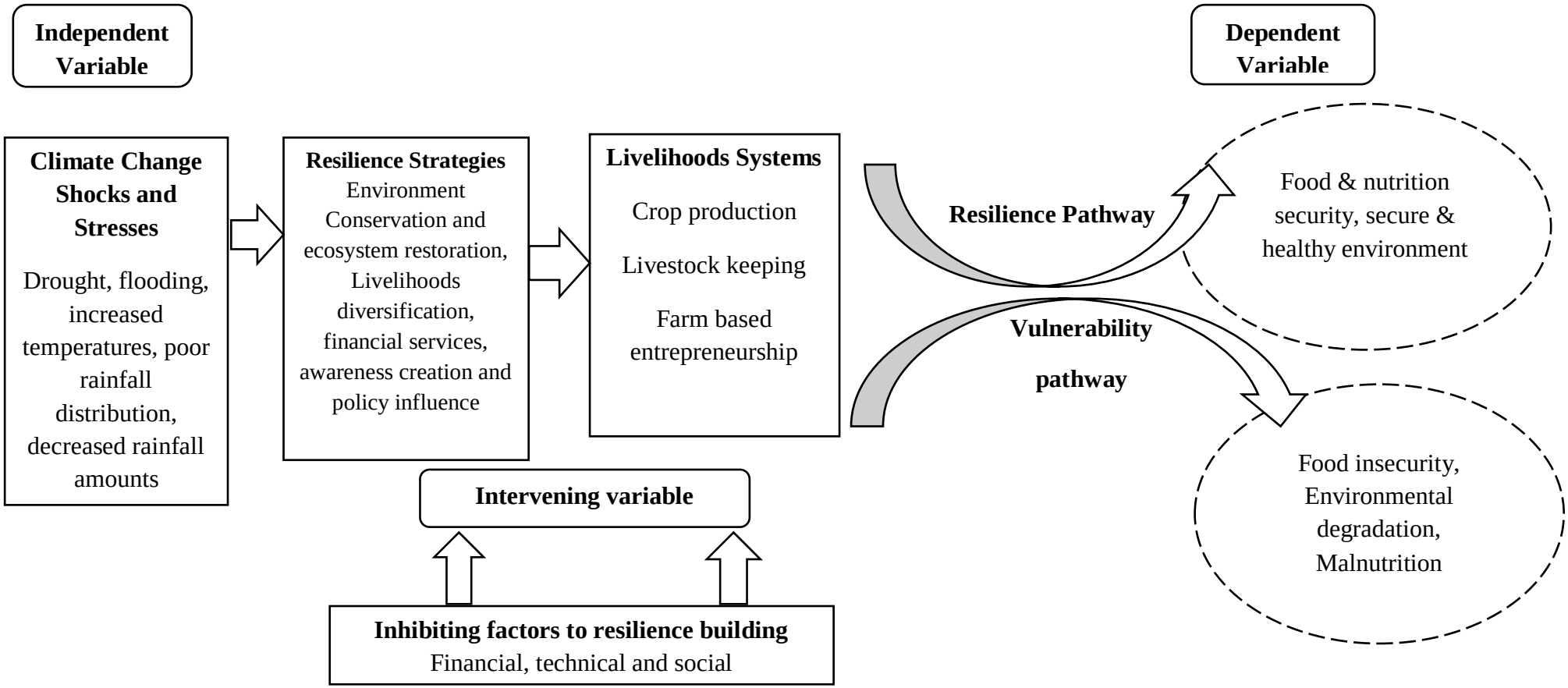

Figure 2: Conceptual Framework

Source: Author

CHAPTER THREE

METHODOLOGY

3.1. Introduction

This chapter outlines the study area; research design; the study population and sample size; data collection methods, data analysis and result presentation, and ethical consideration.

3.2 Study Area

Kalawani location is found in Tulimani ward of Mbooni sub-County in Makueni County. The location is located within 1.5711° S, 37.4361° E and covers an area of 51.7 Km^2. Kalawani location has two sub-Locations (Kalawani and Mavindu). The major physical features in the location include Mbooni hills which lies along the South-West border of the Location with Kithungo Location; seasonal rivers Nguani, Thwake, Kituku, Kikumu and Nduumoni draining runoff water to the eastern side of the location and indigenous shrubs and bushy undergrowth which dominate the land cover. Other features include Mavindu plantation forest and rock outcrops. The study area is generally hilly with an elevation of 1284 meters above the sea level. The location is largely arid and semi-arid and usually prone to frequent droughts. The location just like the larger Makueni County experiences two rainy seasons, namely: the long rains occurring in March/April while the short rains occur in November/December. The rainfall pattern is such that the seasons spread over a short time characterized by heavy storms. In the recent past, short rains have become more reliable than the long rains. The livelihoods of most location residents depend on rain-fed small-scale farming, a practice that is highly vulnerable to the effects of climate change and environmental degradation. Rapid population growth

places enormous pressure on natural and environmental resources such as forests, water, and land. Already scarce resources such as arable farmland must be subdivided among more people, resulting in over-exploitation and low productivity. As the location's population increases, these pressures on resources will be magnified. Makueni County's Integrated Development Plan (CIDP 2013-2017) identified population dynamics, environmental degradation, and climate change as key development challenges. These issues need to be linked in county policies and programs to ensure that projects that address them are implemented jointly.

The location is divided into two sub-locations namely Mavindu and Kalawani. According to the Kenya National Bureau of Statistics, in 2009 the location had a population of 15,595 people. The Location is inhabited by the Kamba-speaking people. There is strong presence and following of Christianity as a religion as evidenced by the numerous churches and church sponsored schools in the Location. However traditional beliefs still hold sway on particular aspects of life and practice. Indeed a few traditional shrines are protected and held sacred for sacrifice offering and worship. Consequently, it is important for all development initiatives to take cognizance of the influence of the church and culture on the behavior of people tapping from its potential as an asset.

The location is served by tarmacked road running from Kikima urban centre to Machakos town. There are several rural feeder roads serving the community to reach water points, schools, churches and markets. However, the roads usually become impassable during the rainy season. This has a net negative impact on perishable horticultural products grown in the location through small scale irrigation agriculture required to reach the market fast.

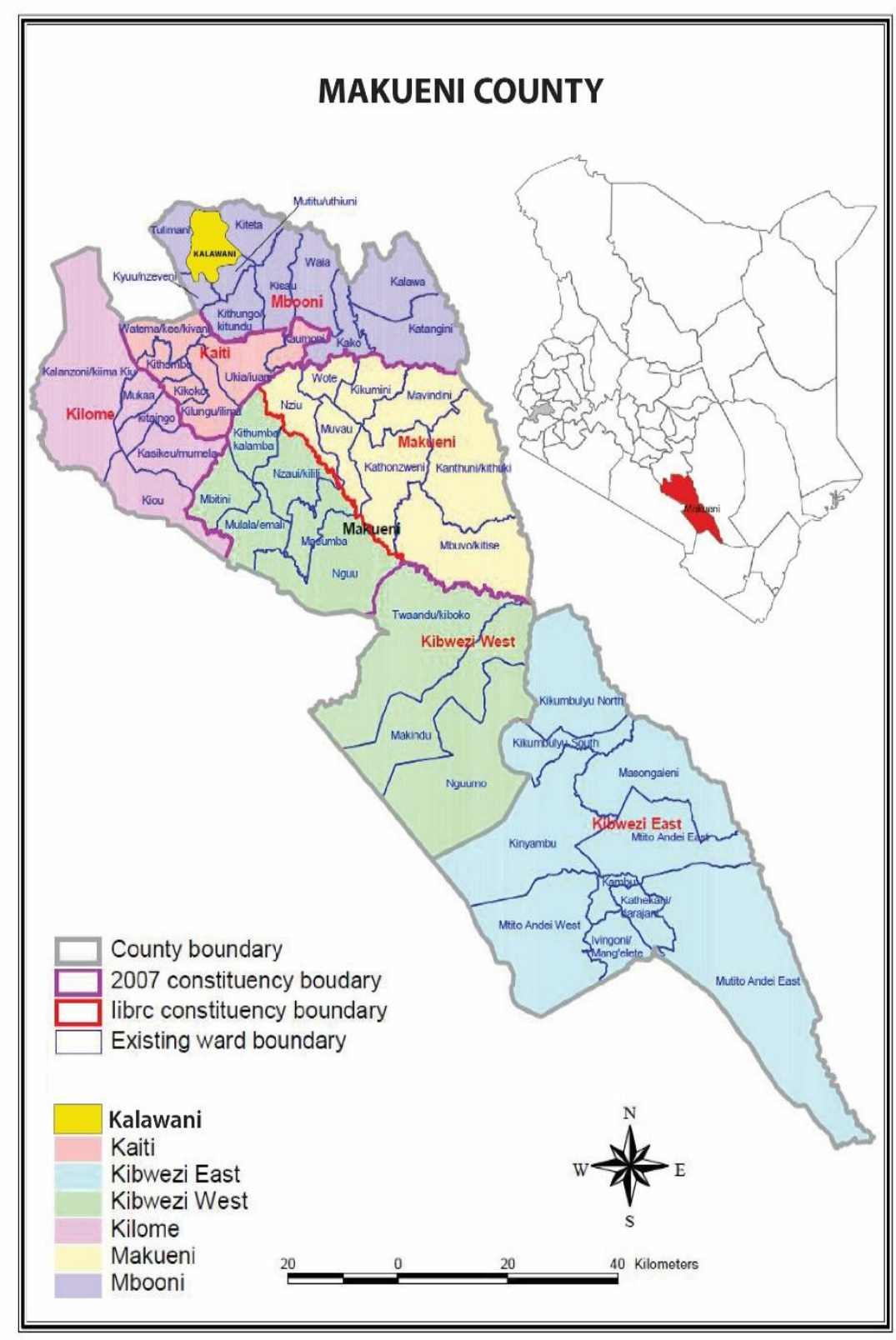

Figure 3: Makueni County Map

Source: Kenya Counties Map

Small scale agriculture forms the economic mainstay of the people in Kalawani Location. Maize, sorghum and host of legumes are grown through mixed cropping mainly for subsistence. Crop failure is common every season due to unreliable rainfall the only difference being the degree to which it does occur. Horticultural crops like French beans, tomatoes, onions and chillies supported with small scale irrigation and mangoes are grown among the few farmers who can afford irrigation services as cash crops.

Sand harvesting is a major economic activity among the male youth increasingly causing conflicts in this semi-arid area with no permanent rivers whose source of scarce water is the sand water reservoirs. A number of households keep livestock like cattle, goats, sheep and chicken which they rely on for milk, eggs, meat and income. From time to time depending on the food insecurity level a number of people relies on relief aid.

Makueni County was the first County in Kenya and among the ASAL counties to legislate on climate change as a measure of addressing vulnerability to climate change. Kalawani location was identified by the County officials as a leading location in the entire county in responding to climate change shocks/stresses. Therefore, it was selected to illustrate policy link between national/county and household/community resilience actions

3.3. Research Design

Research design is the set of methods and procedures used in collecting and analysing measures of the variables specified in the problem research (Creswell, 2013). It provides a logical arrangement for the collection, analysis and interpretation of data in a manner that aims at achieving the research purpose. The study employed cross-sectional survey research method where all the data was collected at one point in time. The study employed a mixed-method approach, which involved both qualitative and quantitative methods. These included reviews

of literature, focused group discussion (FGD), household survey, key informant interviews (KIIs) and field observation using transect walk. Mixed methods refer to an emergent methodology of research that advances the systematic integration, or "mixing" of quantitative and qualitative data within a single investigation or sustained program of inquiry. The basic premise of this methodology is that such integration permits a more complete and synergistic utilization of data than do separate quantitative and qualitative data collection and analysis (Creswell, 2013).

3.4 The Sampling techniques and sample size

Convenient and purposive sampling was used to select key informants and FGDs participants, while systematic random sampling was used in the selection of the quantitative survey respondents. The study population was composed beneficiaries of the RELI programme. The project worked with groups. A list of all project beneficiaries within the location was received from the project implementer. Table 1 contains a list of the beneficiary groups and the number of members making up each group. A total of 22 groups benefitted from the RELI programme. The total membership of the beneficiary groups was 512 (Table 1). This compromised the study population from which a sample was drawn.

Table 1: The study population-Kalawani Location Group Members

Group Name	**Number of members**
1. Mumbuni water project	38
2. Kayamba SHG	37
3. Wikwatyo wa aka Kithetheni	28
4. Ndiuni SHG	24
5. Mumbuni A	28

6. Mumbuni B	29
7. Muselele	28
8. Kyeni Kya Kituku	18
9. Kinyuani youth group	23
10. Tusalukye SHG	26
11. Kyone women group	33
12. Kituku/Kamwinzi SHG	34
13. Kalungu youth group	20
14. Kinyuani/Kituku women group	28
15. Wendano wa Kamusongo	19
16. Kalawani youth group	28
17. Uvaani A	27
18. Kamwinzi	15
19. Kivuioni A	29
20. Kivuioni B	15
21. Kalumu A	28
22. Kalumu B	26
Total	**512**

Source: Field Data

The sample sizes for household respondents to be interviewed was arrived at using Fisher's formula..

$n = Z^2 (pq) / d2$

q=1-p

z=the standard normal deviation, 1.96 corresponding to 95 percent confidence level.

p=assumed percentage of Kalawani households involved in Christian Aid interventions 50 percent.

d=acceptable significance error

q= percentage of Kalawani population not involved in Christian Aid activities 50 percent

n= desired sample size (if target population is more than 10,000).

$n = 1.96^2 *(0.50*0.50)/0.05^2$

n= 3.84 * (0.25)/0.0025

n= 0.96/0.0025

n=384

Since the target population is less than 10,000, the required sample size was smaller. The following formula was used to calculate a final sample estimate (nf).

nf= n / (1+ n/N)

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

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

N= the estimate of the population size

nf= 384/ (1+ 384/512)

nf= 384/1.75

nf=220

A sample of 220 respondents was derived from the population of 512 beneficiaries. The study employed systematic sampling to reach the individual 220 households. The names of the group members were available from the group registers. The total population of 512 was divided by the sample of 220 to get an interval which was used to systematically obtain a sample household. The appropriate interval was 2 since 512/220 =2.3. A list of all the beneficiaries was prepared in alphabetical order and given a serial number. Every second household was sampled and interviewed until the sampled households reached the required 220. No household

was allowed to be interviewed more than once. In the event that a household had more than one beneficiary who was selected on the list, then the second selection was ignored, and the next household picked. It is important to note that the project beneficiaries were not necessarily the heads of the households. They are the ones who were interviewed in the households.

The study carried out six Focus Group Discussions as follows: Three with the beneficiary groups; one VSLA; one beneficiary youth group; and one with the elderly beneficiaries. Thirteen key informant interviews were conducted with the following: The County Director of Meteorology, County Drought Coordinator, County Director of Agriculture, County Director of Livestock, Ward Agricultural Extension Officer, Ward Water Officer, Area Chief, RELI Programme Monitoring and Evaluation Officer, RELI Programme Project Officer, Chairperson of the Umbrella CBO in the Location, and three community leaders

3.5. Data collection methods

3.5.1. Secondary data

a). RELI programme documents including implementation work plan and reports.

b). Various publications of the government of Kenya on climate change policies, strategies, programmes, and plans.

c). Resilience, Climate change, disaster risk management and environment reports prepared by research scholars, universities, and development organizations.

d). Public records and statistics, historical documents, and other sources of published information

3.5.2. Primary data

a) Quantitative data was gathered from 220 sampled RELI programme beneficiary households using interview schedule (Appendix I).

b). Qualitative data was gathered through FGD conducted using the checklist (Appendix II) and KII using the checklist (Appendix III)

c). Further structured observation was conducted using a transect walk and photography to record observed RELI programme interventions.

3.6. Data analysis and presentation

The data was analyzed using descriptive statistics. Data for the Meteorological Department was observed for emerging patterns that characterize drought such as heat stress, reduced precipitation, moisture stress, and increased temperatures. Frequencies, percentages and averages were used to examine the trends in climate change relate shocks and stresses and how they have contributed to making the community vulnerable, establish project interventions and how they have contributed to enhancing community capacity to the identified climate related shocks and stresses and to identify challenges inhibiting households from developing resilience to climate related risks. All the qualitative interviews were transcribed in English and categorized into themes aligned to the study objectives. All figures are reported with a 95% confidence level and 5% margin of error. The analysed data is presented in frequency tables, diagrams, graphs and photographs.

3.7. Data Reliability and Validity

3.7.1. Data Reliability

Reliability was ensured by having objective questions included in the questionnaire and by getting guidance from my supervisor and through expert opinions. Further the study used multiple sources of data and approaches to analysing data through triangulation to enhance credibility of the research study.

3.7.2 Data Validity

The study methodology was planned in a logical way, where each component relates to each other in a structured way. This approach allowed the research to be effective and desired results

to be achieved. A pre-test of data collection and data handling was conducted on a small sample not included on the main sample for the survey. Pre-testing included interviews and focus group discussion based on the populations of interest. Based on the pre-testing, the tools were updated and final tools produced.

3.8. Ethical Consideration

Informed consent was obtained from all respondents. Privacy and confidentiality of the data was also assured. Permission to conduct the research was obtained from Maseno University and the local authorities.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1. Overview of the chapter

This chapter details the findings of the study. The results are on climate change related shocks/stresses (drought, crop pests, livestock diseases, conflicts, and floods), RELI programme interventions (environmental, socio-economic and policy), and the challenges that inhibit households from developing resilience to climate change related shocks/stresses (lack of information, lack of finance, institutional barriers, technology barriers, poor development infrastructure). These in effect help in understanding how the achievements of RELI programme increased community capacity to respond to climate change shocks/stresses in Kalawani Location of Makueni County.

The Main Objective of the Study was to assess the achievements of RELI Programme in increasing the community's capacity to respond to climate related shocks/stresses in Kalawani Location, Makueni County. The specific objectives were ,1) to examine how climate related shocks and stresses contribute to making the people more vulnerable in Kalawani Location;2) to analyze how RELI programme achievements and establish how they contributed to increasing the community's capacity to respond to climate shocks/stresses in Kalawani Location; and 3) to identify challenges inhibiting households from developing resilience to climate related risks in Kalawani Location, The overarching question that the study seeks to answer is 'How did the achievements of RELI programme increase community capacity (ability) to respond to climate change shocks/stresses in Kalawani Location of Makueni County?

4.2 Characteristics of respondents

Respondents' Distribution by Gender

The research sought information concerning the gender distribution of the respondents to ascertain whether the study was gender sensitive (Table 2).

Table 2: Sex of the respondents

Category	Frequency (N=220)	Percentage
Female	143	65
Male	77	35
Total	220	100

Source: Field Data

The study revealed that there were more female respondents than male respondents at 65 percent and 35 percent respectively.

Marital Statuses of the Respondents

The study sought to know information about the marital statuses of the respondents in order to establish their social responsibilities (Table 3).

Table 3: Marital status of respondents

Category	**Frequency (N=220)**	**Percentage**
Married	141	64
Widowed	37	16.9
Single	27	12.3
Separated	14	6.4
Unresponsive	1	0.4
Total	220	100

Source: Field Data

The study revealed that most of the respondents (64 percent) were married, thus majority of the responses could have been more socially responsible. A few respondents had been widowed (16.9 percent) and some were single (12.3 percent). Those who had separated accounted for less than 10 percent of the respondents.

Respondents' household composition

Respondents were asked to give information on the compositions of their households in terms of the households' sizes and the how the households were headed. Responses were analysed and presented (Table 4)

Table 4: Respondents' household's composition

Category		Frequency (N=220)	Percentage
Relation to head of household	Head	77	35
	Spouse	107	48.6
	Child by birth	27	12.3
	Grandchild by birth	9	4.1
Number of members of the household	0-2	32	14.5
	3-5	175	79.6
	6-8	5	2.3
	Above 8	8	3.6

Source: Field Data

The study found that most of the households were composed of less than 5 members (79.6) percent). It was also revealed that most of the respondents in this survey were either the

household head themselves or their spouses with 35 percent and 48.6 percent of the respondents respectively. This showed that the information given was more accurate as the respondents were more knowledgeable in matters related to vulnerability to climate related shocks and risks in the area and better understood Resilient Livelihoods programmes

Level of education of respondents

The study sought to establish the educational level of the respondents with a view to understand their capacity to appreciate the information on climate/weather related risks and shock from different sources. The study revealed that the respondents had varying levels of education (Table 5).

Table 5: Level of education of respondents

Category	Frequency (N=220)	Percentage
Pre-primary	17	7.7
Primary incomplete	20	9.1
Primary complete	47	21.4
Secondary incomplete	49	22.3
Secondary completed	65	29.5
Vocational	15	6.8
University	7	3.2
Total	220	100

Source: Field Data

Majority of the respondents were in the bracket of those who had completed primary school education, incomplete secondary education and completed secondary education at 21.4 percent, 22.3 percent and 29.5 percent respectively.

Respondents' Main source of Livelihood

Respondents were required to indicate their main source of livelihoods as this would inform the research in understanding vulnerability level of the respondents to climate related shock/stresses (Table 6).

Table 6: Respondents source of livelihoods

Category	**Frequency(N=220)**	**Percentage**
Farming	178	80.9
Petty trade	27	12.3
Charcoal burning	2	0.9
Casual labour	52	26.3
Salaried	25	11.4

Source: Field Data

The study revealed that of all the sources of livelihood farming, petty trade, charcoal burning, casual labour and salaries accounted for 80.9 percent, 12.3 percent, 0.9percent, 26.3 percent and 11.4 percent respectively Table (6). A high reliance on climate-sensitive economic activities such as crop and livestock production contribute to community and household's vulnerability to climate change. The agriculture sector which is a vital source of employment, food security, livelihoods and economic development in the study area is particularly vulnerable to the impacts of climate change. From a geographical perspective, Kenya's ASAL**s** are acknowledged as being particularly vulnerable to the impacts of climate change. The highest incidence of poverty is found in these areas and they experience greater competition over resources due to rising populations, natural growth, in-migration from the densely populated highlands, and lower access to infrastructure such as potable water, electricity and telecommunication facilities (Njoka J., *et al*2016). The ASAL economy is highly dependent on

climate sensitive activities, with agro-pastoralism accounting for 90 per cent of employment (IFAD, 2017).

Respondents' Type of Housing

Housing as a basic need and one of indicators of social wellbeing in the society was analysed in-terms of wall and roofing materials (Table 7).

Table 7: Respondents' type of housing

Category		**Frequency (N=220)**	**Percentage**
Housing-wall material	Stones	14	6.4
	Roast bricks	148	67.3
	Raw bricks	23	10.5
	Mud	33	15
	Wood	0	0
Housing-Roofing Material	Iron sheets	184	83.6
	Grass/Makuti	33	15
	Tiles	2	0.9
	Canvas/Polythene material	0	0

Source: Field Data

The study revealed that of all the type of houses owned by respondent's 67.3 percent were of roasted bricks walls while 83.6 percent iron sheets roofs (Table 7). The study also revealed that 3.2 percent of all the houses were constructed using stones and a paltry 0.5 percent of all the houses had tiles.

4.3 Climate Related Shocks and Stresses in Kalawani that Contribute to Making the Community Vulnerable

This section addresses the first research question which reads, "How do the climate related shocks /stresses prevalent in Kalawani Location contribute to making the community vulnerable?" According to the International Centre for Tropical Agriculture Kenya County climate risk profile series report (2016) drought, crop pests, livestock diseases, floods and resource-based conflicts are the most problematic climate change related shocks in Makueni County. It is against this backdrop that the study embarked to interrogate the effects of: - drought; crop pests; livestock diseases; floods; and resource-based conflicts. Shocks are defined within development context, defining them as external deviations from long term trends and deviations that have substantial negative effects on people's current state of well-being, level of assets, livelihoods, or safety, or their ability to withstand future shocks. These negative effects may be short-lived or long-lasting. Human populations already experience a variety of climate related shocks and stresses, which can be defined as physical manifestations of climate variability and change with the potential to have negative effects on the environment and on society.

4.3.1. Drought as a climate related shock

Drought is characterized by heat stress, reduced precipitation, moisture stress, and increased temperatures is the most problematic climate related shock in Makueni County (Government of Kenya, 2013). County analysis of past climatic events and future climatic projections for the County indicate that this shock is likely to increase in frequency and severity. Overwhelming majority of the households in the study area depend on rain fed agriculture for their livelihoods. It goes without saying droughts has been detrimental to the environment. But droughts also have had serious consequences for people's livelihoods, affecting everything from agriculture

to water supply and health in an area where 81 percent (Table 6) of the households relies on agriculture as the main source of livelihoods.

According to the International Food Policy Research Institute (2017) cycles of drought have adversely affected farmers' livelihoods. The agricultural sector in the study area is faced with several challenges. Adding to the fact that the study area is largely semi-arid, the sector is adversely affected by climatic variability. Unfavourable climatic conditions such as drought, high temperatures, and poorly distributed rainfall in space and time result in low productivity and frequent crop failures. This has made production of some crops such as maize, green grams, cowpeas, pigeon peas, and beans less viable. Mango and citrus trees, which are less tolerant to drought relative to other crops, have been severely affected. According to the County Director of Agriculture extreme weather events of prolonged drought effects were witnessed between 2010 and 2011 when several mango and citrus trees dried up throughout the location.

Rainfall and Temperature Trends

To understand the climate shocks described as short-term deviations from the long-term trends, time series analysis for temperature and rainfall was conducted. The time series of seasonal maximum temperatures anomalies for the months of March-May and October- December from Kenya Meteorological Department for Makueni County are presented in Figure 4.

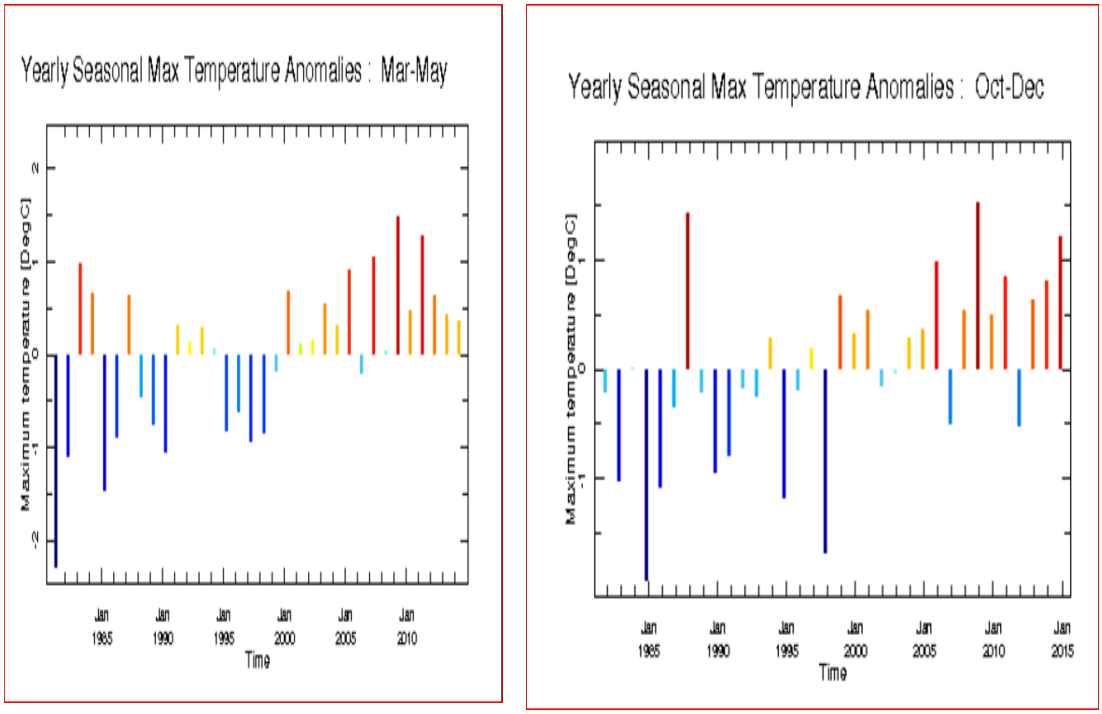

Figure 4: Yearly Seasonal maximum temperature anomalies

Source: Kenya Meteorological Department

The data indicates that in a period of 30 years between 1985 and 2015 Makueni County had experienced more years of unfavourable climatic conditions of high temperatures (Figure 3). The general trend particularly from the year 2000 is of a positive seasonal maximum temperature anomaly for the months of March-May. Similarly, time series for seasonal maximum temperatures anomalies for the months of October to December shows a positive trend of increase in temperature above the normal which has remained steady particularly in the last 15 years pointing towards a departure from normal with more dry and hot seasons experienced. According to the County Director of Agriculture the high temperatures had accelerated evaporation and evapo-transpiration leading to drying up of water sources and wilting of crops. The rising temperatures have made the study area too hot to grow certain crops like maize which is the main staple food crop. The prolonged droughts caused by climate change have reduced the amount of water available for irrigation, domestic and livestock use.

Similarly, the County Director of Livestock observed that high temperatures experienced in the study area and the resultant heat stress caused reduced feed quantity and quality. The County Director of Livestock further opined that unavailability of feeds also made the animals more susceptible to disease hence requiring more veterinary attention. The County Director of Meteorology attributed the increased temperatures to climate change that has direct impact on the livelihood activities such agricultural production major source of livelihood in the study area.

Time series of seasonal maximum rainfall anomalies for the months of March-May and October-December for Makueni County are presented in the Figure 5.

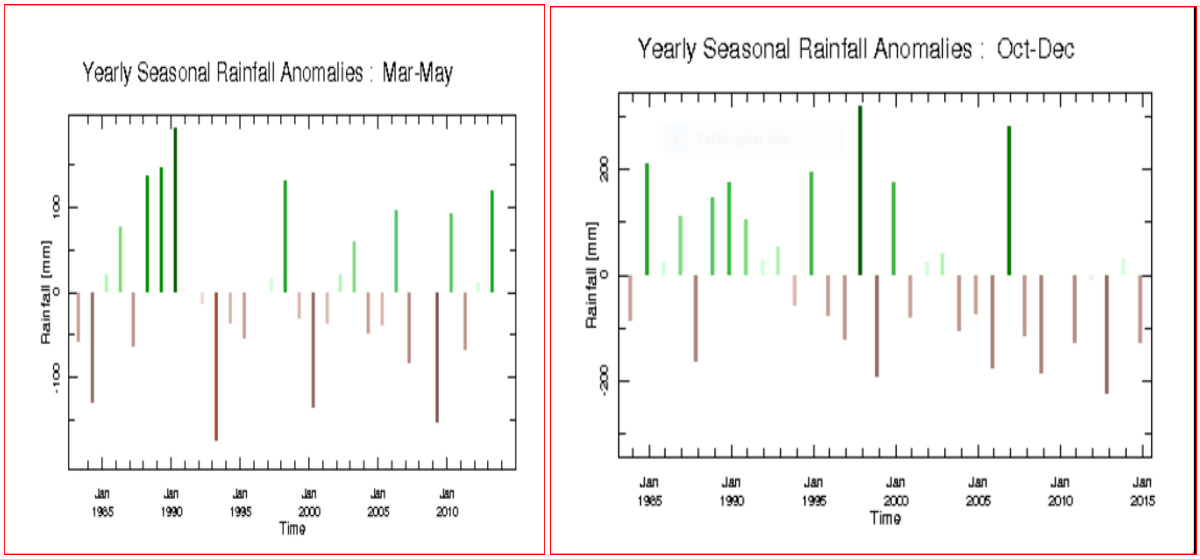

Figure 5: Yearly seasonal maximum rainfall anomalies

Source: Kenya Meteorological Department

The data revealed more years of less rainfall than normal as compared to the years when the rainfall was above normal for both March-May and October-December seasons. In the last 15 years, the March-May and October-December rain season have recorded below normal rainfall amounts save for a few years when the amount of rainfall was normal or slightly above normal.

This demonstrates a clear pattern of less rainfall and prolonged dry spells when it is expected to be wet. Participants recounted in the FGD how the dependency on relief food had increased in the face of reduced rainfall which results to crop failure from one season to another. According to the County Director of Meteorology water availability was a function of the amount of rainfall received and sits at the heart of both the risks and responses to climate shocks. In an interview response the County Director of Agriculture pointed out that the depressed rainfall was directly responsible for reduced soil moisture impacting negatively on both livestock and crop production a major source of food and income, thus contributing to increased vulnerability.

According to the FGD participants the rainfall deficits contributed to crop failure and poor harvest for the smallholder rain fed agriculture besides failing to recharge the water sources and supporting vegetation regeneration which provide fodder for livestock. The Ward Water Officer observed that the impacts of climate change were amplified through water scarcity as many parts of the study area already had experienced water scarcity with changing weather patterns.

Time series of annual temperatures and rainfall for Makindu meteorological station which serves Makueni County are presented in the Figure 6.

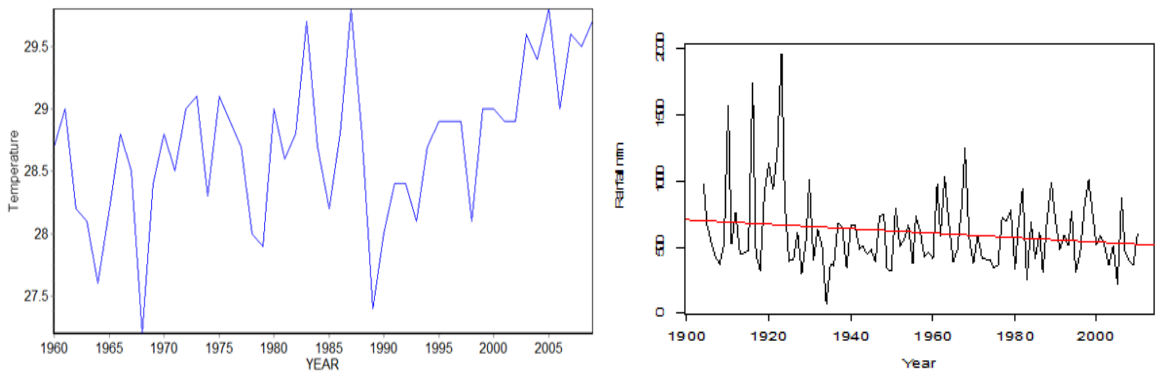

Figure 6: Time series of annual temperatures and rainfall

Source: Kenya Meteorological Department

The data indicates that earlier years of the century were marked by consecutive years of very high rainfall. Except for a few episodes of extremely high rainfall in the early years of the century, annual rainfall does not exhibit extreme cases in rainfall amounts. The study area has experienced a reduced mean annual rainfall from 750mm to 550 mm between the year 1900 and 2000. The mean annual rainfall indicates a negative trend. Though the gradient of the trend is small, it is statistically significant at 5 percent significance level (Kenya Meteorological Department, 2013). This thus confirms statistically a significant variation in the mean state of climate depicting climate change. Further the study shows an upward trend of increase in temperature between 1900 and 2005. The long-term time series analysis of both temperature and rainfall corroborates the finds of yearly seasonal rainfall and temperatures anomalies which pointed to a decline in rainfall amounts and increase in temperature.

Rainfall Onset

The study examined the trends in rainfall onset (Figure 7). The focus was on the average dates of onset of the rains which marks the end of the dry season.

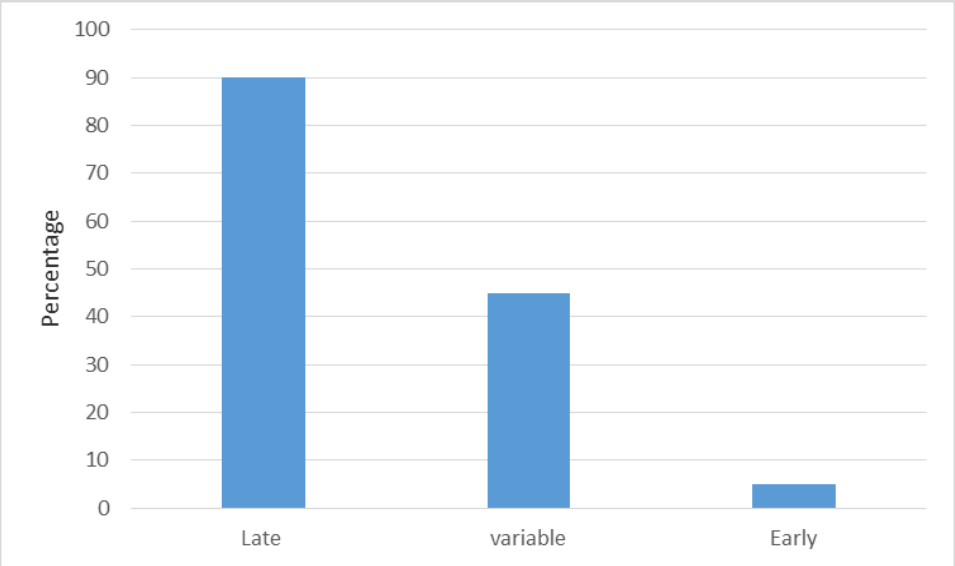

Figure 7: Rainfall onset

Source: Field Data

The study revealed that 90 percent and 45 percent of the respondents reported that the average date for onset of rains was delayed and variable respectively. A small proportion of the respondents at 5 percent were of the opinion that the average dates for onset of the rains comes early. The study area weather patterns are changing. The FGD participants revealed that the change in rainfall patterns has a huge impact on Kalawani Location because majority of the households were dependent on agriculture as the main source of livelihood. The major challenge that households face is timing. It's critical for them to know when rains start and stop to plan for farm operations. The onset of the rains sets suitable conditions for land preparation and planting. The increased variability in the rainy season onset poses socio-economic and developmental challenges which threaten food security and induce poverty. This is so because erratic and delays in rainfall onset affects the community's overall food production and pulses (beans, cowpeas and green grams), which form the main staple food of the community.

Rainfall Cessation

The study established that there was mixed perception of the respondents on rainfall cessation (Figure 8).

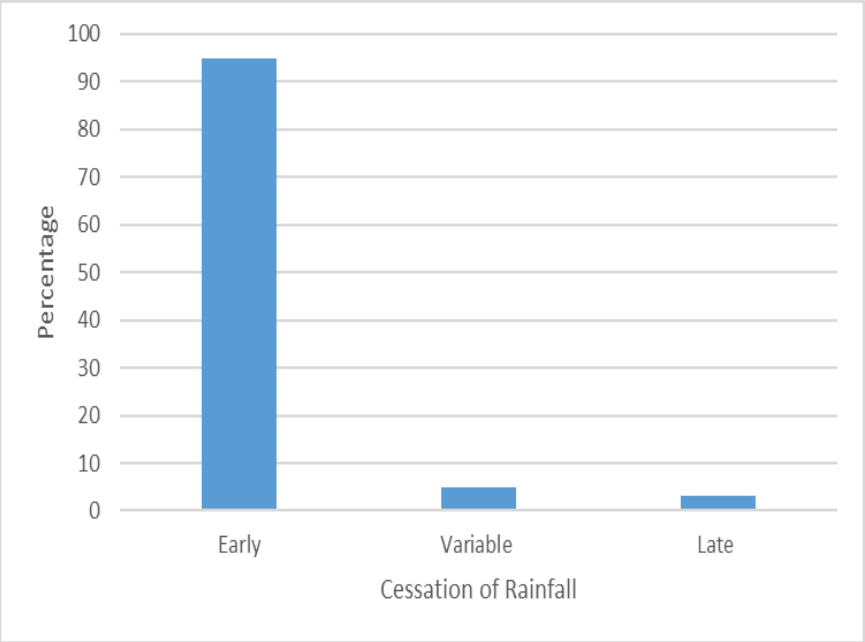

Figure 8: Rainfall Cessation

Source: Field Data

The study revealed that 95 percent of the respondents were of the opinion that the rains stopped early. A smaller percentage of the respondents at 5 percent and 3 percent were of the opinion that the rainfall cessation was variable and late respectively. FGD Participants underscored the importance of rainfall for their livelihoods and said that "no rains" or "no timely and sufficient rains" were the primary risks facing agricultural production. Further the FGD participants revealed that weather changes had not only shortened the growing season but also reduced crop and livestock production. Late onset and early cessation of rainfall as reported by majority of respondents corroborates the time series analysis of rainfall for Makueni County obtained from the Kenya Meteorological Department.

Seasonal Rainfall Distribution

The study sought to establish respondents' perceptions of seasonal distribution (Figure 9). The seasonal rainfall distributions were divided into five categories: normal, more in the MAM season, more in the OND season, mid-season droughts, and variable.

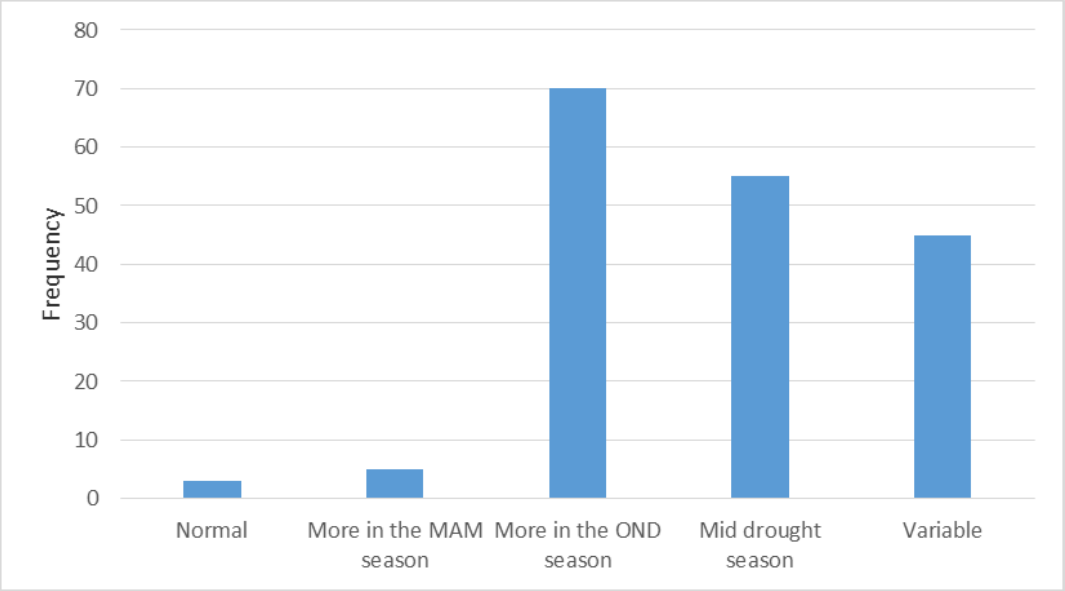

Figure 9: Rainfall distribution

Source: Field Data

The study revealed 45 percent of the respondents were of the opinion that the rainfall distribution was variable than is normal, more in the first season or more in the second season (Figure 9). On the other hand, 55 percent and 70 percent of the respondents reported that the area experienced mid-season drought and more rainfall in the OND season respectively. Smaller proportion of the respondents reported a normal rainfall pattern and more rainfall in MAM season at 3 percent and 5 percent respectively. The FGD participants reported a shift in rainfall distribution with the OND season getting more precipitation. The OND season has become more reliable for crop growing as it enjoys better distribution of rainfall, but the increased mid-season droughts usually impact negatively on the crops leading to failure and

poor harvest a common cause of food insecurity and loss of income. Further the FGD participants reported mid-season droughts as common happening which poses risk to crops in the farms and water availability. A review of the meteorological data on reported and observed data for the past two decades established that seasonal variability had become cyclic.

Changes in Temperature

The study sought to establish respondents' perceptions on the changes in temperatures over time. Respondents' perceptions to changes in temperature were grouped into four categories: lower, moderate, higher and variable (Figure 10).

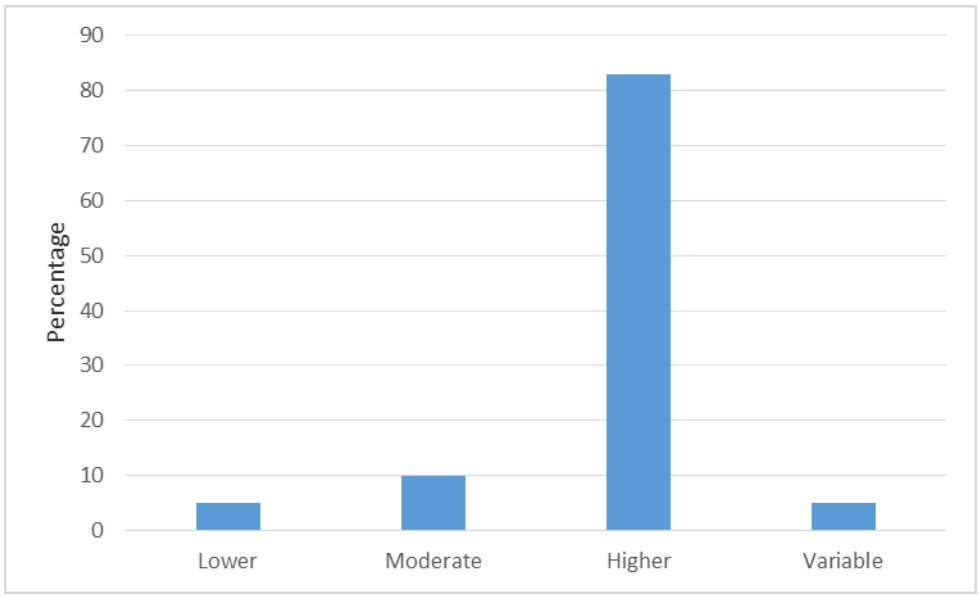

Figure 10: Changes in temperature

Source: Field Data

The study revealed that 82 percent of the respondents were of the opinion that the area has experienced an increase in temperature while 10 percent, 5 percent and 4 percent of the respondents were of the opinion that temperature variations has been moderate, lower and variable respectively (Figure 10). The FGD participants reported that temperatures have

generally increased and reached extremes in the recent years, with low temperatures in experienced the morning and evening, and high temperatures during daytime. The extreme temperature variations and dry spells have been reported to contribute to more pests (like white ants) and disease prevalence for both livestock and crops. Diseases such as Newcastle, Coccidiosis, Fowl pox, Chicken flue and Gumboro for chicken, Rift Valley Fever (RVF) and pneumonia for cattle, goat and sheep have become more pronounced. Mango fruit fly has become more resistant to pesticides and was reported to be a menace during periods of increased temperature and heat stress. In the words of one of the participants in FGD 'the high temperatures are so unforgiving particularly when rainfall cessation comes early, farmers are left watching their crops withering in the scorching heat'.

Frequency and Severity of Drought

The study sought to establish the frequency and severity of drought occurrence (Table 8).

Table 8: Drought Incidences Experienced in Makueni County

	2005	2006	2007	2008	2009	2010	2011	2012	2013
No. of drought incidences	none	none	None	1	1	1	1	none	none
Total area affected by drought	none	none	None	6026 km^2	6026 km^2	6026 km^2	6026 km^2	none	none

Source: National Drought Management Authority

The interview with National Drought Management Authorly (NDMA) County Drought Coordinator and literature review revealed that frequency and severity of prolonged drought had increased in Makueni County in the last decade. According to NDMA Makueni County Drought Coordinator the severity of drought has had far reaching consequences on the livelihoods of the vast majority of the people in the county who depend on rain fed agriculture as the main source of livelihoods. Drought impacts key sectors which play an important role to the economy and livelihoods of the households. Prolonged drought covering the entire County including the study area was experienced in four consecutive years between 2008 and 2012 (Table 8). The findings revealed that years of years of severe prolonged droughts affecting the entire County corresponds with years of highest mean temperatures (Figure 3). Participants in FGD reported increased frequency and severity of prolonged drought. Participants in FGD reported that prolonged droughts deplete household's food stocks, causes spiking of food prices and reduces quality and quantity of pasture for livestock use and escalates water scarcity forcing residents to walk long distances to access water for domestic and livestock use. Further the participants narrated how distress sale of livestock (asset stripping) which entails panic off take to forestall mortalities leads to oversupply and collapse of terms of trade. Most households sell livestock to buy food which unfortunately at such times sells at very high prices. The impact of drought on the livelihoods is well captured in the saying of one the key informants "For many years drought has been a common problem in this area but what has been witnessed in the recent past is exceptional". The prices of basic food commodities skyrocket during periods of prolonged drought as the market price of livestock depreciates forcing farmers to sell up to five goats to buy 90kg bag of maize."

The impact of Drought on Crops

The study sought to establish the impact of drought on crops production (Table 9)

Table 9: Effect of drought on crops

Effect of drought	Frequency of respondents (N=220)		Percentage	
	Yes	No	Yes	No
Stunted growth	154	66	70	30
Crop failure	198	22	90	10
Wilting of crops	169	51	76.8	23.2
Lack of planting seeds	62	158	28.2	71.8

Source: Field Data

The study revealed that of all the effects of drought on crops 70 percent, 90 percent, 76.8 percent and 28.2 percent caused stunted growth, crop failure, wilting of crops and lack of planting seeds respectively (Table 9). Crop failure was the leading effect of drought on crops reported by most respondents at 90 percent while lack of planting seeds was the least effect of drought on crops reported by 28.2 percent of the respondents. According to the FGD the increased frequency of drought events in most instances causes crop failure in varying levels dependent on the severity. The FGD respondents enumerated the indirect impacts of drought on crops like increased food insecurity and reduced income levels at households' levels. The FGD participants thought that drought adversely impacted on crop production because most households relied on rain-fed agriculture in a situation where the weather has become increasing erratic and unpredictable. Poor rainfall distribution characterized by late onset and early cessation shortens the growing seasons resulting to stunted growth and wilting of crops. According to both the County Director Agriculture and Livestock low harvest, loss of income, increased food and nutrition insecurity among others were some of the direct and indirect impact of drought on crops.

Impacts of drought on livestock

The study sought to establish the impact of drought on livestock (Table 10).

Table 10: Effects of drought on livestock

Effects of drought on livestock	Frequency of respondents (N=220)		Percentage	
	Yes	No	Yes	No
Poor livestock body conditions	169	51	76.8	23.2
Reduced feed availability	205	15	93.2	6.8
Reduced livestock productivity	200	20	90.9	9.1
Reduced water availability	110	110	50	50
Livestock death	35	185	15.9	84.1

Source: Field Data

The study revealed that of all the effects of drought on livestock 76.8 percent, 93.2 percent, 90.9 percent, 50 percent and 415.9percent were related to poor livestock body conditions, reduced feed availability, reduced livestock productivity, reduced water availability and livestock death respectively (Table 10). The FGD respondents reported that a combination of insufficient feeds and water results to reduced productivity of livestock especially of dairy animals. The County Director of Livestock reported that animals with poor body conditions had reduced productivity and fetched low market prices adversely affecting food security and income levels of the households.

Between 2005 and 2013 the study area experienced four years of severe drought incidences (Table 8). Seasonal rainfall patterns have also been erratic affecting crop yield and livestock productivity has significantly changed with late onset and early cessation reported. Climate

change driven prolonged drought had increased and intensified thereby putting the lives of many households and their social and economic activities at risk (GOK, 2010). The study area has suffered a series of droughts which have had devastating socio-economic and environmental impacts. A chronology of the droughts in the study area indicated that their frequency and severity had increased. In the past decade alone four drought episodes were experienced. A key observation is that rainfall has become irregular and unpredictable characterised by poor distribution, late onset and early cessations shortening the production season for crops (Figure 6), (Figure 7), and (Figure 8). The actual observed temperature trends indicate significant warming. Majority of the households depends on rain fed agriculture of keeping livestock and growing crops making them very vulnerable to drought shocks (Table 6). Crop and livestock production which forms the economic mainstay of many households have suffered loss from climate change driven prolonged droughts (Table 9) and (Table 10). Crop failure and stunted growth attributed to drought among other effects has led to reduced productivity with food insecurity and loss of income. Similarly, drought and high temperature result in reduction in feed quantity and quality affecting resulting to reduced livestock productivity, water scarcity, and poor livestock body conditions and in extreme cases livestock death. According to the FGD participants the households practising mixed farming in the study area, rely on animals as buffer assets bolstering household food and nutrition security besides being a source of income relied on to support acquisition of other basic needs like health and education for most households. At the peak of droughts, the terms of trade collapses. This is so because agriculture is the backbone of the economy in Kalawani. Further the household's food stocks are depleted and food prices skyrockets.

The study findings on the impacts of drought on crops and livestock corroborate well with analysis of Kenya National Development report on the impact of drought on Kenyan economy (UNDP, 2013). The analysis established that between 2003 and 2007 the country suffered one

of the most devastating droughts estimated to have led to the loss of 70 percent of the livestock. Moreover, the 19198-2000 drought is estimated to have cost the country at least 16 percent of the GDP in each of the years 1998/1999 and 1999/2000 (World Bank, 2007), while the 2008 - 2011 one led to a 2.8 percent annual slowdown in economic growth, thereby costing the country KES. 968.6 billion (GOK, 2012). About 90 percent of the disasters for instance in this country are attributed to drought and flooding (GOK, 2018). The consequences of increased frequency in droughts are far reaching, particularly for vulnerable groups, including women who are responsible for water management at the household level (GOK,2018). All over the developing world, women and girls bear the burden of fetching water for their families and therefore spend significant amount of time daily hauling water from distant sources. Given the changing climate and the attendant result of increased frequency and severity of drought, access to water does not only affect women, their responsibility as primary givers, it also impacts on agricultural production and care of livestock

4.3.2. Crop Pests as a climate related shock

The five most important climate variables that affect crop production are temperature, rainfall, humidity, atmospheric pressure, wind, sunshine and cloud cover. Crop production is inherently sensitive to climate variability and change due to close natural connections and dependencies that exists between climatic weather conditions and plant development. Impacts of climate change are affecting the economic and non -economic dimensions of people's lives, including subsistence practices of communities that are experiencing decreases in agriculture productivity and quality, and increase in pests (Savo et al., 2016). Climate change is a major concern for agricultural communities worldwide (Coakley, S. et al. 199). Changes in climatic parameters greatly affect crop production and susceptibility to pests as well as insect pest longevity. Climate change affects crop pests and disease susceptibility which in turn affects

crop health, and these changes cause a decline in productivity. High temperatures for example, are likely to reduce crop yields, at the same time, introduce new pests and strains.

Given climate change, the study sought to establish the trend in the incidences of crop pests (Table 11).

Table 11: Crop pests' incidences

Crop pests' incidences	Frequency of respondents (N=220)	Percentage
Increased	171	77.7
Normal	15	6.8
Decreased	7	3.2
Variable	27	12.3

Source: Field Data

The study revealed that there was increased incidences of crop pests and diseases as reported by 77.7 percent of the survey respondents (Table 11). A smaller proportion of the respondents were of different opinion with 6.8 percent reporting that the trend in incidences of crop pests had remained the same, 3.2 percent reported decrease in incidences of crop pests, and 12.3 percent of the respondents were of the opinion that crop pests' incidences remained variable (Table 11). The County Director of Agriculture reported that crops pests and diseases are major cause of crop failure and reduced production which collectively contributes to food insecurity, reduced income and high cost of production. Climate change induced prolonged droughts and increased temperatures are associated with the occurrence of crops pests and diseases which is major cause of crop failure and reduced production.

Types of Crop Pests

The study sought to establish the type of crop pests and disease in the community (Table 12).

Table 12: Occurrence of types of crop pests and diseases

Types of Crop pets	Frequency of respondents (N=220)	Percentage
Common occurrences and diseases	138	62.7
Rare pests and disease event	34	15.4
Evolving Pests and disease event	48	21.9

Source: Field Data

The study revealed that occurrence of common crop pests and diseases as a key challenge to crop production as reported by 62.7 percent of the survey respondents. A smaller proportion of the survey respondents at 15.4 percent and 21.9 percent were of the opinion that the occurrence of rare and evolving pests and diseases incidences were the main challenge to crop production respectively (Table 12). The FGD participants reported identifying pest typology which they are unfamiliar to particularly attacking all maize varieties grown in the location. In an interview with County Director of Agriculture he confirmed that the Maize Lethal Necrosis which was first reported in Kenya in 2011 is widespread in the county. He pointed out that all current maize varieties grown in the county were susceptible resulting to heavy yield losses by farmers. According to the divisional/ward crop officer, climate change is direct driver of the spread of the plant pests. Further the FGD participants. Reported that Kalawani location and the larger Makueni County are known for fruit production particularly mangoes which is a major source of income for smallholder farmers. The FGD respondents reported that the fruits are facing major threat of fruit fly infestation which affects the quality and quantity of marketable fruits.

The FGD participants reported that the major challenges in mango production include pests - mainly fruit fly, disease such as rust and anthracnose, scarcity of water which leads to high abortion rates, and small fruit sizes. The extent to which fruit fly infestation occurs is a factor of the prevailing weather conditions. The weather extremes of increased temperatures are known to favour the multiplications of fruit flies which affects the mango trees lowering quality of fruits and causing mango trees to abort fruits.

As the weather patterns shifts in the study area with more extreme events like prolonged droughts reported new evolving crop pests and diseases have emerged (Travis, et al., 2015). There is an emergent of the occurrence of rare and evolving crop pests and diseases which has presented new challenge to farmers since there are no known control measures for the type of crop pests and diseases. According to the County Director of Agriculture one of the most direct ways in which crop pests and diseases have impacted agriculture in the study area is through reduced production. This results in direct economic loss to farmers, which cascade along the entire value chain, affecting the growth of the entire sector or even economy. Reduced agricultural production and the corresponding economic loss contributed to by incidences and occurrence of crop pests and diseases remains one of the most direct factors contributing to increased vulnerability in the community. The most direct economic impact of crop pest or disease is the loss of agricultural production of crops which reduces farm income. The severity of the economic loss is significantly high for households which entirely depends on agriculture for food and income. The impacts of reduced productivity on crops can be long-lasting. Pest infestations can impair fertilization rates or seed recovery, while pesticide applications can harm soil and water fertility.

Results of experiments to assess the effects of climate change on crop productivity in India and rest of the world show potential impacts of devastating pathogens and insect pests may change,

thus corroborating the study findings (Sengar, *et al*., 2014). The assessment established change in the crop–pest relationship because of climate (mainly temperature) which plays a dominant role in the distribution and development of pests in the following ways: increases in the rate of development and number of generations produced per year, extension of the geographical range beyond the present margin of distribution, earlier establishment of pest populations in the growing season and increases in the risk of migrant invasion and exotic species. A major factor in global warming could be greater survival through over-wintering and persistence of plant diseases and insects. With higher atmospheric concentration of carbon dioxide, plants will grow faster and accumulate more carbohydrates and nitrogen (Hugo, et al., 1994), changing the feeding habit of insects (Fajer, et al., 1989), which will lead to higher pest density and intense damage. Pests, such as aphids and weevil larvae (Staley, & Johnson, 2008), respond positively to higher carbon dioxide. Increased temperatures also reduced the over-wintering mortality of aphids, enabling earlier and potentially more widespread dispersion (Zhou *et al.*, 1995). The sub-Saharan Africa migration patterns of locusts are influenced by rainfall patterns (Cheke, & Tratalos, 2007). Warming or drought may change the resistance of crops to specific diseases or through increased pathogenicity of organisms by mutation induced by environmental stress (Gregory, et al., 2009). The severity of disease in oilseed grape could increase within its existing range and can also spread northward over the next 10–20 years (Evans *et al*., 2008). Changes in climate variability may also be significant affecting the predictability and amplitude of outbreaks (Gornall, *et al.*, 2010). In areas of the world where a large proportion of the population is dependent on a single crop or a few crops they are at bigger risk of crop failure owing to one or more devastating diseases. At the present time, the threat is particularly great in developing countries, where populations are growing fastest, poverty is endemic, the population depends on locally produced staples and the infrastructure of extension and research and development is often poorly resourced. The occurrence of plant

pests and diseases pose grave socio-economic consequences as it affects food and nutrition security, human health, livelihoods, trade and economic development.

According to the IPCC's Fifth Assessment Report (2014), changes in the climate over the last 30 years have already reduced global crop production by 1 – 5 percent per decade relative to a baseline without climate change. In addition, recent studies indicate that even 2 degrees increase in global temperature will affect crop productivity, particularly in the tropics, and this impact will rise with increases in temperature (Said, et al. 2018).

4.3.3. Livestock Diseases as a climate related shock

The study sought to examine the community perceptions around the seasonal incidences of livestock diseases through FGD comprised of elderly women and men who reported increased incidence of livestock diseases coinciding with drought events (Table 13).

Table 13: Drought and livestock diseases incidences

Events	1971-1980	1981-1990	1991-2000	2001-2010	2011-2016
Livestock numbers	++++++++	++++++++	++++++	++++	++++++
Livestock diseases	++	++++	++++++	++++++++	++++++++
Annual rainfall received	++++++++	++++++++	++++++	+++	++
Drought Occurrence	+	+++	++++++	++++++++	++++++++++

Key + represents weight or magnitude

Source: Field Data

The perceptions of the respondents on the seasonal incidences of livestock disease occurrence for the past 46 years revealed increased incidences of prolonged drought coinciding with occurrence of livestock diseases (Table 13). Over the past two decades, droughts have become more frequent and intense, especially in sub-tropical regions (Masih, et al. 2014). These droughts are characterised by periods of below average precipitation resulting in prolonged water shortage and low forage quality and quantity (Nangombe, et al.2018). The agricultural production environments have, as a result, become fragile. This has narrowed down agricultural production activities to livestock production. Livestock production, however, is also likely to suffer on the hands of the frequent droughts which vary with time and region (FAO, 2016). As the frequency and severity of drought increased so did the incidences of livestock diseases. According to the information availed by the County Director of Agriculture on the distribution of infectious livestock diseases, extreme weather events of drought and El Niño coincided with increased incidences of livestock diseases (Table 13). For instance, while the El Niño phenomenon of 1997 and 1998 brought about good and plenty of pasture for livestock, there was an outbreak of goat and sheep blue tongue disease. Similarly, the prolonged drought of 1984 not only led to the severe East Coast Fever problems but also lack of pasture and water causing death of many animals. This is corroborating the FGD participants response on the incidences of livestock diseases that were most pronounced in the years that drought was experienced/reported (Table 13). Between 1991 and 2016 there is an upsurge of livestock disease cases corresponding with increased frequency and severity of drought.

Table 14: Distribution of infectious livestock diseases

Year	Event
1970-1980	Outbreak of foot and mouth disease and massive vaccination of livestock High livestock deaths
1981-1990	Severe East Fever problems, severe drought of 1984, death of livestock
1991-2000	Elnino of 1997/1998 good and plenty of pasture for livestock, outbreak of goat and sheep blue tongue disease Severe drought in 2000
2001-2010	Severe drought of 2008/2010, outbreak of new castle disease causing death of many chickens in all households in the location
2011-2016	New castle disease 2013/14, East Coast Fever outbreak

Source: Makueni County Department of Agriculture)

Livestock disease was identified as one of the climate related shocks that make the community vulnerable**.** The burden of livestock disease is significantly high in the years when drought was experienced most like between 1991-2000, 2001-2010, and 2011-2016. There was an upsurge of livestock infectious diseases which according to the FGD participants marked the beginning of increased variability in weather patterns punctuated with prolonged drought. Crop pests and animal diseases are among the costliest disasters in Africa accounting for over USD 6 billion in agricultural loss between 2005 and 2015. (Xu *et al*., 2016). Developing countries feature relatively high burdens of disease in humans and animals. Among the endemic diseases affecting these countries, tropical diseases are prominent, comprising a variety of often vector-borne parasitic, protozoan and infectious diseases (Bennett**,** 2009). As well as drought, a

combination of other factors plays a role. In livestock, the high disease burden goes hand-in hand with low productivity levels. It is likely that some of the greatest negative impacts of climate change on livestock will be felt in grazing systems in arid and semi-arid areas. Exacerbated drought conditions reduce forage and range productivity and may contribute to overgrazing and land degradation (Altizer *et al.,* 2011).

Threats to livestock resources such as droughts, natural disasters and animal diseases, can seriously affect the economic and social balance of local communities (GOK, 2018). Higher temperatures associated with prolonged drought may increase the rate of development of pathogens or parasites that spend some of their life cycles outside their animal hosts, but high temperature and drought will also have a strong disinfecting effect. Changing wind patterns affects the spread of certain pathogens and vectors, particularly the infective spores of anthrax and blackleg, the wind-borne peste des petits ruminants and dermatophilosis (Bett, 2016)). In contrast, diseases such as avian influenza, bovine tuberculosis, brucellosis, foot and mouth disease, Newcastle's disease, which are transmitted through close contact between animals, have been reported to have associations with drought (Hager, 2007). Drought and desiccation are inimical to most pathogens. Changes in rainfall and temperature regimes may affect both the distribution and the abundance of disease vectors, as can changes in the frequency of extreme events (Bett, 2016). Arthropod vectors tend to be more active at higher temperatures; they therefore feed more regularly to sustain the increase in their metabolic functions, enhancing chances of infections transmitted between hosts. Small changes in vector characteristics can produce substantial changes in disease (Bett, 2016). Climate change can also influence disease transmission by altering ecosystem structure and function. IPCC (2007) estimates that 20-30 percent of the world's vertebrate species are likely to be at increasingly high risk of extinction from climate change impacts within this century if global mean temperatures exceed 2-3° C. This would reduce the ability of ecosystems to dilute disease

transmission through biodiversity. Further human behaviour may change as the result of climate change and this may affect how we keep animals, which in turn may affect the exposure or vulnerability of animals to pathogens or vectors (Bett, et al., 2016).

FGD participants reported that poor quality forage, especially during periods of scarcity, causes nutritional stress and disease that undermines livestock performance. Significant variations in certain weather elements of rainfall and temperature observed in the area may have modified the ecosystems of the diseases causing an increase in pathogens and vectors populations. For the small-holder households practicing mixed farming, livestock is relied on as a buffer asset particularly during periods of extended extreme weather events like prolonged drought leading to crops failure. In the interview response the County Director of Livestock reported that emergence of livestock diseases associated with dry periods causes reduced production and productivity of livestock leaving the households with no alternative source of food and income and vulnerable to food and nutrition insecurity. In the words of one of the FGD participants 'households invest their income in livestock keeping as a form of 'bank savings for the lean periods of poor rainfall and prolonged droughts'. Thus, the upsurge of livestock diseases directly causes reduced livestock production eroding back on buffer assets and contributing to reduced resilience and accelerated vulnerability.

The early warning system should be developed to predict climate change driven prolonged droughts in arid and semi-arid areas and information network on targeted and strategic disease management interventions that moderate the multiplication of disease-causing pathogens and their vectors because of climate variability be developed (Mariner & Paskin, 2013)In addition, extension education should be used to enlighten the pastoralists on the importance of disease control, stocking density of animals and environmental conservation in order to mitigate against climate variability.

4.3.4 Conflicts as climate related shocks

The study sought to examine seasonal trends of conflicts in the study area over a period of three years between 2012 and 2014. The reported incidents of conflicts related to natural resources and particularly those around access and use of water were analysed. Data was collected on incidents of conflicts reported at the Chief's office. The analysis revealed an upsurge of conflict between the months of June and October on one hand and between the months of December and February (Figure 10). An analysis of monthly rainfall for three years of 2012, 2013 and 2014 reveal that the amount of rainfall received in Makueni County was least between the months of June and September and December and February. The driest months coincides with high incidences of reported conflicts.

FGD participants composed of women, village leaders and youth reported that prolonged drought accelerated incidents of conflicts. The reported incidents of conflicts revolved around access to water points and grazing fields. Some conflict incidents spilled over to social violence pitting individuals and clans against each other with cases of injuries and damage to property reported. FGD women participants singled out the adverse effects of conflicts which hindered water access as curtailing their social -cultural responsibility of providing water for families. Further women reported that often during the prolonged drought periods and where access to certain water points were prone to conflicts, they resorted to do with inadequate water for domestic use compromising on hygiene and sanitation standards predisposing members of the households to infections. According to them number of women had suffered from violent conflicts with physical injuries inflicted.

FGD youth participants were of the view that that prolonged drought and the resultant reduced water volumes makes it practically impossible to equitably share irrigation water between downstream and upstream small-scale irrigation farmer groups to which they are members. The

youth reported that upstream farmers often obstructed most of the water leaving the downstream farmers with little or no water for irrigation. The conflicts over irrigation water has in some instances degenerated to violent conflicts leading to destruction of water distribution pipelines.

The village leaders among the FGD participants recounted how incidents of water conflicts peaked during the prolonged drought period. They reported increased frequency and scale of drought is worsening water scarcity causing conflicts and security challenges. They confirmed that to a large extent the conflicts were localized and confined to water points involving small irrigation farmers and women collecting water for domestic use. The issue of power relations, negotiations and rights greatly influenced competition and cooperation. Overall, all the participants reported conflict related to access to natural resources on which their livelihoods are dependent. This was on water access for domestic use; irrigation agriculture; livestock use; and community pastureland.

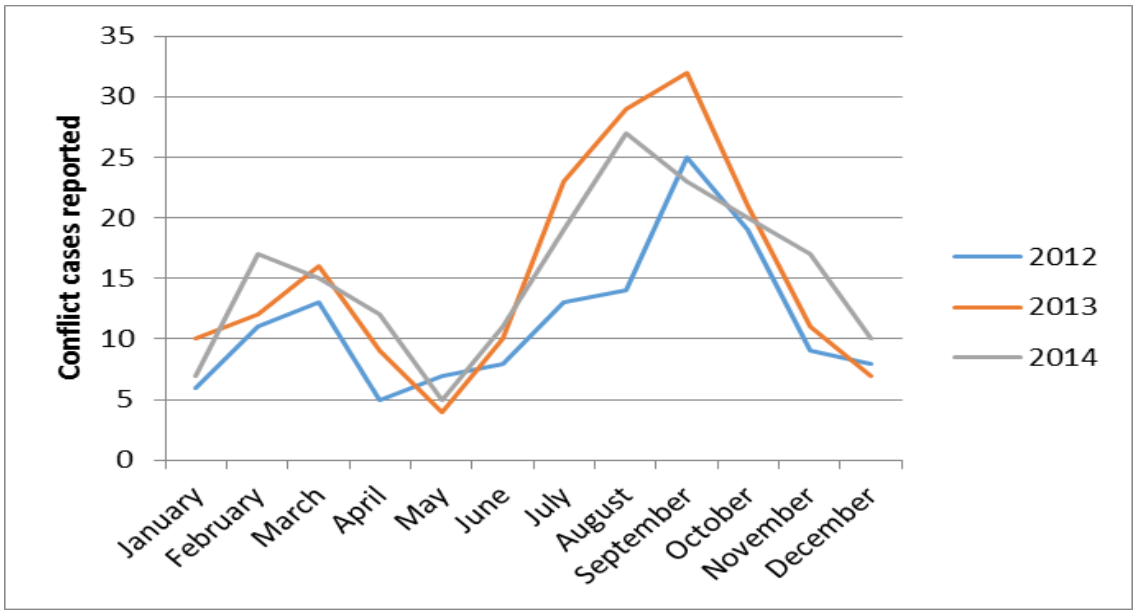

Figure 11: Conflict trends

Source: Chief's Office

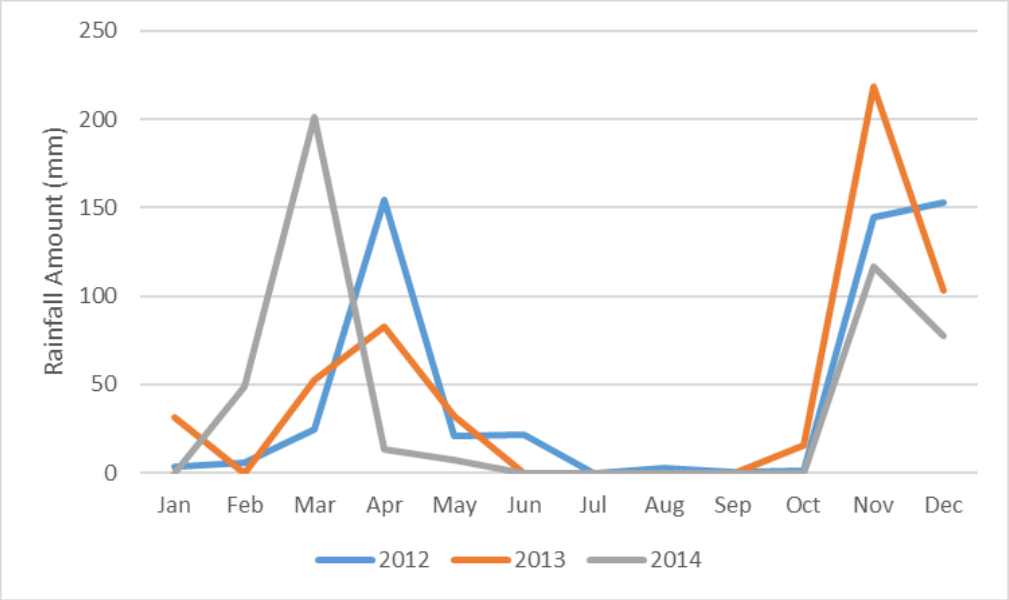

Figure 12: Makueni Monthly Rainfall 2012-2014

Source: Kenya Meteorological Department

The study revealed that incidents of conflicts peaked between the months of June and September when there was least rainfall for the years 2012, 2013 and 2014 (Figure 11). The evidence indicates that there is a positive comparison between increased incidences of conflicts and drought exemplified by reduced rainfall amounts of less than 50mm (Figure 12).

Climate change, one of the biggest challenges of the 21st century, not only presents an extra challenge in coping with conflicts in dry lands but also in understanding the complexity at their roots. Drought periods correlate positively with increased incidences of ethnic conflicts, which together determine pastoralists grazing pattern in north-western Kenya (Berger, 2003 & Moru, 2010). When insecurity is high, livestock herds tend to concentrate in small secure grazing zones, leaving large tracts of land along the borders between communities unused (Moru, 2010). It is estimated that between15 and 21 percent of north-western Kenya remain insecure and therefore inaccessible each year (Morton, 2001). This is attested by the abandoned dry season grazing areas on the territorial borders between the Turkana and Pokot; Turkana and

Karamojong of Uganda; Pokot and Karamojong and the Pokot and Samburu communities of northern Kenya. However, pastoral conflicts are not adequately explained by resource scarcity theories alone but also by the dynamics of cooperation and co-optation within communities, as well as the theories of economic and political ecology (Okello, et al.2005).

The high climatic variations observed over the past few decades increase risks and uncertainties that threaten the well-being of most rural communities that depend on natural resource-based livelihoods (IPCC,2014). Climate variability manifests in extreme events notably droughts which have increased in frequency and severity over the past three decades (IPCC, 2007). Understanding of drought as a factor in resource-based conflicts is therefore, critical in Kenya's dry lands given the increased rainfall unreliability associated with climate change. In Kenya, an analysis of rainfall data from the ASALs reveals widespread droughts in 1960/1961, 1969, 1973/1974, 1979, 1980/1981, 1983/1984, 1991/1992, 1995/1996, 1999/2000, 2004/2006, and 2008/2009 (GOK, 2018). The current decline in water and pasture resources in Kenya's ASALs have been linked to recurrent and prolonged droughts (Morton, 2006). In other studies, it has been confirmed that prolonged droughts and water scarcity are not the only causes of the water-related conflicts but there are multiplying factors where other vulnerabilities to conflict are present (Kloos, et al., 2014). Pluralistic institutions and their embedded power relations, land tenure systems and other pre-existing factors play a role in water accessibility and the resulting water related conflicts. Existing research shows that drought can increase the risk of conflict and alter the dynamics of existing conflicts (Pierre-Yves, et al., 2006)

4.3.5. Floods as a climate related shock

The study sought to establish the effects of floods on the community (Table 15).

Table 15: Effects of floods on the community

Effects of floods on the community	**Frequency of respondents (N=220)**		**Percentage**	
	Yes	No	Yes	No
Loss of crops	156	64	70.9	29.1
Loss of livestock	0	220	0	100
Damage of houses	22	198	10	90
Loss of household items	33	187	15	85
Loss of income	139	81	63.2	36.8
Damage to road infrastructure	26	194	11.8	88.2

Source: Field Data

The study revealed that the effects of flooding on the households and the community as loss of crops, damage of houses, loss of household items, loss of income, and damage to road infrastructure reported by the respondents at 70.9 percent, 10 percent, 15 percent, 63.2 percent and 11.8 percent respectively (Table 15). Loss of livestock from flooding was the least of all the effects of the flooding reported by no respondent. The FGD participants reported that flooding hardly affected the livestock production. Further the participants reported that the study area is largely dry and that the flash floods usually overflow downstream from Mbooni hills affecting crop farms along rivers Nguani, Thwake, Kituku, Kikumu and Nduumoni on the downstream.

Projected precipitation and temperature changes imply possible changes in floods (IPCC, 2007). In Kenya, Opondo (2013) shows loss of human life was the most severe impact of floods. In Mozambique Brida et al., (2013) show loss of sense of place occurred after flooding in the central districts of Caia and Mopeia, flooding had a devastating impact on homes and

livestock (Brida et al. 2013). The impact of flooding in Kenya is felt across various sectors of the economy including agriculture, livestock, transport, housing, public health, industrial processing, and tourism (Otiende, et al., 2008). In a study focusing on the effects of flooding for lower Kano, Otiende (2008) established that thousands of people in the flood-prone area were displaced and rendered homeless following destruction of their homes leading to internal displacement. Buildings and business premises were also affected during floods (ibid, 2008). The destruction of irrigation infrastructure had an impact on the livelihoods of those dependent on irrigated agriculture. Herds of livestock died from drowning in the floodwaters during the El Niño flood of 1997/98. Pastoralists suffered from reduced incomes of which 68 percent was derived from livestock. This resulted in the complete collapse of the main source of income amongst the pastoralists and agro-pastoralists. In addition to direct loss of animals, the decrease in livestock marketability also affected income level. Food consumption was also affected due to the decreased production of milk and meat from livestock. The loss of income also translated into loss purchasing power. The combination of low purchasing power and high food commodity prices worsened the situation as farmers are unable to purchase due to no income from agriculture. This corroborates with research findings in Kalawani location.

A study to establish the impacts of floods on livelihoods and vulnerability of natural resource dependent communities in Northern Ghana revealed a decline in environmental quality after the floods (Armah, et al., 2010). The study further established that after floods, swamps emerged, and this became breeding grounds for water-borne diseases due to water stagnation. According to this study the other effects of flooding included destruction of settlements, by physically breaking down houses, grain stores and socio-economic infrastructure. The study also points out that floods led to the destruction of crops and farm animals. Further the study revealed that as a result of flooding, there was accumulation of massive quantities of silt on structures such as water supply, sewage treatment and this paralyzed life-support and

ecosystem services. This study basically concentrated on the negative effects of floods. However, it should be noted that floods also come with positive effects. For instance, apart from silt blocking various structures they play a huge role in soil fertility. It is this soil fertility that promotes agriculture. Increased soil fertility and uninterrupted agricultural activities are put together then abundant and quality yields will be achieved. When abundant and quality yields are realized then the living standards of farmers is likely to be attained.

Serious flooding has increased in the Niger Basin in the last two decades with the risk of flooding increasing with rising temperatures (Aich *et al.*, 2014; Amogu *et al.*, 2010). In the Sub-Saharan African region, the populations of Mozambique and Nigeria are projected to be most affected by sea-level rise in terms of the absolute number of people flooded annually (Hinkel *et al.*, 2011). Assuming 126 cm (64 cm) of global mean sea-level rise above 1995 values by 2100, which corresponds to upper bound (median) estimates in a 4^0C temperature rise of the world, and assuming no adaptation.

Approximately 2 million more people in Mozambique would be exposed to annual flooding than in scenario without sea-level rise, while in Nigeria approximately 3 million more people would be flooded annually. In terms of the proportion of the total national population affected by annually flooding, Guinea-Bissau, Mozambique and Gambia are most severely impacted (Ibid, 2011). Sea-level rise exacerbates the risk of coastal flooding associated with tropical cyclone activity. A medium sea-level rise scenario of 0.3 m by 2050 could see current 1-in 100-year storm surge events in Maputo, Mozambique for example, occurring once in every 20 years (Neuman *et al.*, 2013). Mozambique, along with Madagascar are particularly vulnerable in a study of the combined impacts of sea-level rise and cyclonic storm surges (Brecht *et al.*, (2012). It is projected that Mozambique and Tanzania are among those countries in the developing world most exposed across several indicators (proportion of total land area, GDP, urban land

area, agricultural area and wetland area exposed) to a 10 percent intensification of storm surges along with 1-m sea-level rise (Dasgupta, *et al.*, 2011). This goes a long way to demonstrate the major risk posed by flooding.

4.4. Project Interventions and How they Contribution to Increasing the Community's Capacity to Respond to Climate Related Shocks and Stresses

This section addresses the second research question which reads, "In what ways do the RELI programme interventions contribute to increasing the community's capacity to respond to climate related shocks/stresses in Kalawani Location?'' The section presents an overview of the RELI project and analyses how project interventions contributed to increasing the community's capacity to respond to climate related shocks and stresses. The study examined project interventions in three broad categories namely, environmental, socio-economic and policy and how they have contributed to increasing resilience of the community and households. Farmers use a wide range of climate smart agricultural technologies and strategies to cope with climate change and climate variability. Soil moisture conservation and management, soil fertility management; water harvesting for domestic use and crop irrigation and on farm diversification were among the most common practices used. Other strategies included planting of drought tolerant crops, seed bulking, agroforestry and rehabilitation of degraded lands and off-farm livelihoods diversification, village savings and loaning and policy advocacy. Farmers often use a combination of these technologies and practices to enhance agricultural productivity.

4.4.1. Overview of RELI programme

RELI programme was expected to directly benefit vulnerable people, especially those living at risk of climate shocks/stresses by helping them become more resilient. The targeted households and community livelihood support was accompanied by establishment and training of

community self help groups on environmental protection and promotion of adaptation strategies to climate change, socio-economic empowerment and livelihoods diversification which included village savings and loans association (VSLAs), and awareness raising and sensitisation about policy on disaster risk reduction. The Department for International Development (DFID) which funded the programme believed that in order to enhance the well-being of vulnerable people, supported programmes needed to contribute to improving resilience to shocks and stresses associated with climate extremes and disasters.

Christian Aid the implementing organization is an agency of 41 sponsoring Christian churches in England and Ireland that is mandated to work on relief, development, and advocacy for poverty reduction. In 2011 Christian Aid secured from DFID to implement NELI programme in Makueni County. Due to high vulnerability level to climate change shocks/stresses, Kalawani Location was selected for the project implementation. The RELI programme focused on supporting adaptation interventions to enhance capacity of the households to respond to climate change shocks/stresses through trainings and technical capacity support. The programme funding was for a period between 2011 and 2017 intended to promote development of livelihoods strategies that are resilient to long- and short-term climate shocks/stresses. The programme was expected to contribute to resilient livelihoods benefitting residents of Kalawani Location in three broad outcome areas viz:

1- To empower target communities to adapt climate change shocks/stresses by taking organized actions to increase their resilience. 2

2- To reduce and respond to the climate change risks in target community, by promoting awareness on disaster risk reduction.

3-To enable vulnerable households in the community actively manage key natural resources and adapt livelihoods strategies to respond to climate change shocks/stresses.

The programme approach was to address acute vulnerability to climate change shocks/stresses working with member-based community-based groups/organization. The programme cycle management focused on promoting conditions that ultimately made communities less vulnerable to shocks and stresses related to climate change.

4.4.2. Environmental Interventions

For this category of project interventions, the study examined soil moisture conservation and soil fertility management interventions to reveal to what extent they had been adopted by households and how they had contributed to increasing the community's capacity to respond to climate related shocks and stresses. All RELI programme beneficiaries were supported and trained on a number of soil moisture conservation and management techniques to increase capacity to cope with climate change related shocks especially drought.

Soil moisture conservation and management

The study sought to establish level of adoption of adaptation interventions promoted by RELI programme (Table 16).

Table 16: Adoption levels for Soil moisture conservation and management interventions.

Soil moisture conservation and management	**Frequency (N=220)**		**Percentage**	
	Yes	No	Yes	No
1. Use of grass strips	73	147	33	67
2. Soil bunds	174	46	79	21
3. Terracing and contour farming	163	57	74.	26
4. Use of cover crops	97	123	44	56
5. Small scale irrigation agriculture	172	48	78	22

6. Rainwater harvesting (sand dams, earth dams, farm ponds, roof and rock catchments) for agricultural production and domestic use	167	53	76	24
7. Mulching	55	165	25	75
8. Average adoption rate			409/7=58%	

Source: Field Data

The study revealed that small scale irrigation agriculture, rainwater harvesting, use of soil bunds, and terracing were the most adopted soil conservation and moisture management practices reported by 78 percent, 76 percent, 79 percent and 74 percent of the respondents respectively. Use of grass strips, cover crops and mulching were the other soil conservation and practices adopted at a lower of less than 50 percent (Table 16). The average adoption rate was 58 percent. According to the FGD participants RELI programme had supported individual households to practice soil moisture conservation management helping to reduce exposure to dry spells, improving rainwater infiltration into soils and greater water use efficiency. Similarly, rainwater harvesting interventions such as construction of sand dams and small lined ponds among others had provided opportunities for diversification, both through crops and livestock contributing to risk spreading in the face of climate shocks. Most of the FGD participants reported rainwater harvesting and storage as a major improvement in their livelihoods and protection from climate shocks particularly drought which is common in the location.

The County Director of Agriculture and the Ward Agriculture Extension Officer reported increased adoption diverse soil moisture conservation and management practices as result of

RELI programme support. They specifically mentioned rainwater harvesting and storage as having multiple benefits, not only for crop production and diversification but also alleviating the burden of collecting domestic water supply, also to provide water for animals and for small income generating activities. Further they pointed out that mulching whose adoption was picking up as a result of RELI programme support helps moderate soil temperatures, suppress diseases and harmful pests, and conserve soil moisture.

Soil fertility management

The study sought to establish the level of adoption of soil fertility management practices promoted by RELI programme that were adopted by beneficiary households. This covered interventions with respect to soil fertility management which included use of compost manure, backyard manure, green manure, inorganic fertilizers, use of green manure and how they had contributed to increasing the community's capacity to respond to climate related shocks and stresses

Table 17: Soil fertility management practices

Soil fertility management practice	**Frequency (N=220)**		**Percentage**	
	Yes	No	Yes	No
1. Compost manure	68	152	30.9	69.1
2. Backyard manure	61	159	27.7	72.3
3. Inorganic fertilizers	58	162	26.4	73.6
4. Green manure	33	187	15	85
Average Adoption rate			100/4 = 25%	

Source: Field Data

The study revealed that among all the soil fertility management practice interventions adopted, 30,9 percent, 27.7 percent,26.4 per cent and 15 percent were compost manure, backyard

manure, inorganic fertilizers, and green manure respectively. (Table 17). The average adoption rate was 25%. The FGD participants reported that households adopting soil fertility management practices had experienced increased farm productivity which resulted to improved food and nutrition security. The improved productivity increased resilience to climate change shocks and potential greater yield variability in the face frequent drought. According to County Director of Agriculture the improved soil fertility and water holding capacity enhances resilience to climate shocks of the natural resources' dependent on for livelihoods by individual households.

Conservation and rehabilitation of natural resources

Further the study sought to map different environmental conservations interventions by way of transecting walk involving beneficiary group members and key informants. The group transect walk explored environmental conservation interventions and agricultural farming adaptation technologies promoted by RELI programme by observing, asking, listening, looking and taking photographs.

Plate 1: Well conserved farm using contour and terracing for soil and moisture conservation in Kinyuani village Kalawani Location.

Plate 2: An Earth Dam at Kwa Mutuku Village constructed through the support of the project to address water shortage

Plate 3: Community members planting trees in a community land in Kinyuani Village.

Plate 4: One of the groups' trees nurseries supported with a shed net at Mbuku village

The transect walk revealed implemented adaptation technologies promoted by RELI programme on contour farming (Plate 1), rainwater harvesting (Plates 2) and tree planting (Plates 3 & 4).

Walk in the location and holding key informant interviews with farmer group leaders and government line ministry officials drawn from department of agriculture and livestock development

Table 18: Conservation and rehabilitation of natural resources Activities

Activity	**Impacts**
Rehabilitation/ protection of degraded areas	Natural regeneration of degraded sites on the upstream of Rivers Thwake, Kikumu, Nduumoni and Kituku covering an area estimated cover 5 KM^2. Rehabilitation of unproductive lands for pasture, tree growing and crop production. The rehabilitated land is source of pasture for livestock during the dry season and growing of crops.

Improved access to water and other natural resources	Accelerated small-scale irrigation agriculture, livestock watering leading to improved agricultural production and incomes, more time for other economic activities. Improved access and utilization of water helping in supplementing natural precipitation when drought set in enabling farmers to produce crops.
Agroforestry and tree planting	Conserved environment and supply of fruits, fodders and firewood for households. This supports food and nutrition security besides earning income for households
Soil and water conservation techniques	Reduced soil erosion, improved soil moisture retention supporting crop growth and pasture regeneration making the farms productive in the face of increased soil erosion and prolonged drought.

Source: Field Data

Further speaking with key informants and group beneficiaries during the transect walk revealed the impact and benefits of the project interventions some of which were public common good investments in increasing the capacity of households and the community to effectively respond to climate related shocks (Table 18). The observed interventions included rehabilitation of degraded areas, improved access to water and other natural resources, agroforestry and tree planting together with various on farm soil and water conservation techniques

Soil conservation adoption rate was moderate (58 percent) for 7 interventions with 4 interventions experiencing high adoption levels of 70 percent and above (Soil bunds, terracing, rain harvesting and irrigation). The study found that compost manure, backyard manure, inorganic fertilizers and green manure were the soil fertility management practices adopted by household's 37 percent, 40 percent, 32 percent and 15 percent respectively. The four soil

fertility management interventions reported low adoption levels with no intervention experiencing an adoption rate of over 50 percent.

Soil moisture conservation and management controls soils erosion and enhances water catchment while the incentives for adopting soil fertility practices included increased crop yields, improved soil fertility, and enhanced plant germination potential and growth rates (Mugwe, et al., 2019). The variety of water-related interventions in the project site show the centrality of water in developing the capacity of communities to respond e and increase effectively to climate change related shocks and stresses. In Kalawani most interventions were water related. They include practices that retain the surface runoff in the uplands and improve water holding capacity of the soil, also practices that increase groundwater recharge and protect the topsoil. This was achieved by constructing hillside terraces with trenches, stone check dams on hillside, cut-off drains, trenches and micro-basins.

In addition, water harvesting methods were undertaken in an attempt to reduce the number of months without water and diversify livelihoods. This included excavation of ponds on homesteads and farmland, earth pans and sand dams in which water was stored and used for domestic purposes, to water animals and for horticulture. These interventions have decreased the time and labour required to fetch water, while also increasing the household income through the availability of high value horticultural products.

Well conserved soils retain soil fertility and are capable of supporting crops and pasture growth in situations of depressed rainfall (Karuku, 2018). It is argued that major water investments in agriculture are required to cope with climate change induced prolonged drought shocks. There is evidence that improved access to water for domestic and agricultural use throughout the year ensures that that farmers can grow crops without depending on rainfall which has become erratic and unreliable. Accelerated small-scale irrigation agriculture prevents crop failure when

drought happens, and the rains are not adequate. The constructed water structures like sand dams and earth dams' avails water for livestock and domestic use saving time for both men and women which they apply in carrying out other beneficial economic activities. Similarly, improved access to water for the households have contributed to better hygiene and sanitation cutting back on incidences of water borne diseases associated with weather extremes like drought and flooding. Water plays a vital role in both food and energy production, and in sustaining the ecosystems that support agriculture and other economic activities that are critical for achieving food security (Hamidov, & Helming, 2020). Further Agroforestry practices have proved to possess high adaptation potential, benefits and impacts among the smallholder farmers in the developing countries (Mbow, *et al* 2014). Agroforestry systems and activities are known to enhancing water use, storage and efficiency in the farms thus boosting productivity among other ecological functions. Agroforestry also plays an important economic role by diversifying on farm income and food sources, spreading income risks, stabilizing/enhancing livelihoods, improving farm productivity and profitability. In terms of social and survival roles agroforestry provides multiple food and energy sources during extreme weather events, providing social security through sale of trees during crisis period and improving nutrition through fruit production.

4.4.3. Socio-Economic Interventions

All RELI programme beneficiaries were supported and trained on socio-economic activities especially on farm livelihood diversifications and Village Savings and Loans (VSLAs). A number of trainings were specifically designed to make households more adaptive to their environment including trainings on income generating activities. The main aim of these trainings was to ensure that household members diversify their income and aim to include as increase risk management in the face of climate change shocks.

On Farm Livelihoods Diversification

The study sought to examine the extent to which on farm livelihoods diversification had been adopted and contributed to increasing the community's capacity to respond to climate related shocks/stresses (Table 19).

Table 19: Proportion of farmers practicing on farm diversification technologies

On farm Diversification Practice	**Frequency (N=220)**		**Percentage**	
	Yes	No	Yes	No
1. Intercropping	189	31	86	14
2. Kitchen gardening	99	121	45	55
3. Practising mixed farming/ integration of livestock and crops	165	55	75	25
4. Agroforestry	119	101	54	46
5. Use of new crop varieties e.g. Cadam sorghum	92	128	42	58
Average Adoption Rate			302/5=60.4	

Source: Field Data

The study revealed that of all the on-farm diversification practices adopted intercropping, kitchen gardening, mixed farming, agroforestry and use new crop varieties accounted for 86 percent, 45 percent, 75 percent, 54 percent, and 42 percent respectively (Table 19). The average adoption rate for livelihoods diversification was moderate at 60.4 percent. FGD participants reported that by diversifying, households increase the range of potential food and income

sources available to them. Consequently, crop diversification serves as an important climate shock management strategy for households by spreading the risks. According to the County Director of Agriculture by diversifying, households increase the range of potential food and income sources available to them. Crop diversification serves as an important climate risk management strategy.

Village Savings and Loaning Associations (VSLAs)

The study sought to examine the usefulness of the financial services the groups provide and explores the role Village Savings and Loans Associations (VSLAs) play in supporting the livelihoods of members in the face of climate change shocks (Table 20).

Table 20: VSLAs Contributions for August 2015- March 2016

VSLAs GROUPS	**MEMBERSHIP**		**TOTALS**	
	M	**F**	**SAVINGS**	**SOCIAL FUND**
Group 1	2	26	2,677,350	10,770
Group 2	3	23	1,196,150	10,910
Group 3	12	11	720,566	8,960
Group 4	4	22	1,072,790	9,910
Group 5	0	33	423,680	8,030
Group 6	15	19	453,180	9,640
Group 7	15	5	750,510	8,960
Group 8	0	28	1,046,300	10,800
Group 9	9	10	597,300	8,960
Group 10	13	14	416,940	8,680
Group 11	14	15	360,470	8,960

Group 12	6	9	956,416	8,650
Group 13	12	16	2,113,620	9,295
Group 14	17	20	1,662,750	10,150
Group 15	17	21	875,568	10,840
Group 16	9	15	393,977	4,800
Group 17	9	19	927,659	5,250
Group 18	11	18	637,043	7,410
Group 19	4	24	547,200	5,670
Group 20	4	14	855,096	14,840
Group 21	11	4	748,420	13,340
Group 22	6	9	338840	8,640
TOTAL	**47**	**513**	**19,771,825.00**	**203,465.00**

Source: Field Data

From the financial records, the study revealed that over the eight months to end of March 2016 total cumulative shares were Kshs. 19,771,825 and total cumulative social funds were Kshs. 203,465 for 22 VSLAs (Table 20). The study took a closer look at the inputs, outputs and outcomes associated with VSLAs which were delivered alongside a range of resilience interventions in 22 groups in Kalawani Location.

The total indirect beneficiary reach was understood to be an individual multiplied by six as this is the average household size in the project's operating area according to the latest census figures (only one member is allowed per household in the scheme) meaning a total reach of 3363 individuals for the 22 VSLAs. It was evident from the VSLAs data findings that the members had managed to increase a saving portfolio from which they would get loans to support resilience interventions in their farms and other livelihoods related activities. FGD participants enumerated several examples of where VSLAs had impacted farm productivity.

This is so because savings are an asset, not liability, and therefore reduce livelihood risks. These findings subscribe to the findings of Costella C., Weingarten L., (2019) that many people in the rural areas who have accessed financial services have been able to purchase agricultural inputs; maintain infrastructures; contract labour for planting/harvesting; transporting goods to market; make/receive payments; manage peak season incomes to cover expenses; invest in education; shelter, health; or deal with emergencies.

The study sought to establish the total cumulative loans and contributed shares (Table 21).

Table 21: Loans and shares for 22 VSLAs (Cumulative August 2016 -March 2017)

Total loans/savings	**Total amount per group**	**Average per group**	**Average per member**
Total cumulative loans	35,589, 285	1,617,694	63,552
Total contributed shares	19,771,825	898,719	35,306

Source: Field Data

The study revealed that in over the eight months to end of March 2016 total cumulative shares were Kshs. 19,771,825 and total cumulative loans were Kshs. 35,589, 285 (Table 21). It was established that through the VSLA Building Resilience and Adaptation to Climate Extremes and Disasters (BRACED) project interventions in West Darful Sudan, participating households had become more resilient at the household level for an average saving between 2,693 and 5,000 US dollars per VSLA group (Bahadur, A., et al. 2015). Firstly, the capacity of the households to absorb the most common shocks, such as droughts, conflicts and fires, had increased as they ventured more into business investments less reliant on a single source of income, both in income-producing individuals and trade**s.** According to

The FGD participants reported that households used the acquired loans to purchase improved farm inputs which helped them cope better with climate change shocks, increased cultivation

of different varieties of crops including the drought tolerant crops, paying school fees and buying household items among others.

The study sought to establish how the social economic activities supported by RELI programme had contributed to increasing capacity of the households to cope with climate shocks through FGD (Table 22).

Table 22: Group Social-Economic Activities

Activity	**increased capacity to cope**
Livelihood diversification	Enhanced resilience through decreasing dependence on climate sensitive crops and livestock.
Seed bulking of drought tolerant crop varieties	Timely access of drought tolerant crop seeds for early planting to take advantage of the short growing season. Growing of drought crops having the ability to withstand high temperatures and depressed soil moisture to grow to maturity and get harvest for food and selling for income.
Village Saving and Loans Scheme	Buffer assets for use in time of drought and source for financing small enterprises among and buying of farm inputs for early dry planting to manage the drought situation. Enhanced financial literacy and small-scale business for women through Village savings and loaning (VSL) among women and men to engage more productively hence contributing to community resilience

Source: Field Data

FGD participants reported that they considered VSLAs, seed bulking of drought tolerant crop varieties and livelihoods diversifications as key activities as key activities which brought them

together to discuss and explore strategies of effectively responding to climate change related shocks besides other development matters concerning the location (Table 22). The study revealed that livelihoods diversification enhanced households' resilience by reducing dependence on climate sensitive crops and livestock and seed bulking of drought tolerant crops contributed to timely access of drought tolerant crop seeds for early planting to take advantage of the short growing season.

The findings revealed that adoption rate for on farm livelihoods diversification was moderate (60 percent) for 5 interventions. Intercropping and mixed farming were most adopted on farm diversification technologies at 86 percent and 75 percent respectively. Village Savings and Loans Associations (VSLAs) had brought financial services to the community where access to formal financial services was typically very limited. Overall, the promotion of the VSLAs led to improved financial inclusion, household business outcomes, and women's empowerment. There was also evidence of improved resilience: in households affected by drought, households experienced improved food security and income. Members of the VSLAs used their savings to obtain loans to enable them to invest in adaptation technologies like irrigation farming from which they got money to support their children through school besides meeting other basic needs. Focused group discussion participants reported enhanced resilience in their households through embracing livelihoods diversification, group seed bulking to avail timely access of drought tolerant crop seeds for early planting to take advantage of the shortened crop production season caused by climate change driven erratic weather.

Intercropping and mixed farming are major forms of on farm diversification which has helped households to adapt to climate related shocks (Gil, 2017). On farm diversification helps farmers to cope and adapt better to climate change shocks as it helps in risk spreading. The high level of adoption of intercropping and mixed farming among the households as an adaptation technology is evidence that the two technologies are appropriate to the local context and they

have proved effective (Table 19). According to the FGD participants mixed farming and intercropping is partly driven by the fact that most of the respondents are smallholder farmers who wanted to optimise on the use of their pieces of land for maximum benefits. Crop–livestock diversification (mixed cropping, intercropping and crop rotation) is a common practice in Makueni County in general and in the study area. Livelihoods diversification spread the risks of crop failure in the face of increased frequency and intensity of drought. Livelihoods diversification had helped communities and households to improve livelihood and food security by increasing production and income options. In effect livelihoods improved economically.

According to the FGD participants embracing of drought tolerant crop varieties had contributed to increased food security. In addition, they continue to contribute to the sustainability of economic activities. The project interventions of alternative livelihood activities helped to enhance group members' adaptive capacities and resilience to face climate related shocks through, livelihoods diversification and small-scale irrigation agriculture. Most of the community members were found to have changed their livelihoods from the practice of growing one crop which was mostly maize and increasingly involved in production of different drought tolerant crop varieties and practising mixed framing (Table 19). Through the project the community members had diversified their livelihoods and were earning more income, more food secure and better informed on decisions to make in the event of drought.

The FGD participants reported that village savings and loaning schemes was a major activity linked to supporting both on farm and off farm diversification particularly for women group activities. The VSLAs schemes not only availed easy access of finance for households to use for investments in adaptation interventions but also served as a social safety buffer which member households relied on during times of shocks. According to the RELI project officer, targeted capacity building in terms of financial management and diversification of income

generating activities went a long way in enhancing climate change resilience capacity at household level. Community members had more income for use in buying food and meeting other economic obligations such as putting up decent houses and paying for farm inputs such as certified seeds and fertilizers. The findings revealed that there were more women than men involved in village savings and loans schemes (Table 20). The village savings and loaning schemes have proved to be effective in building buffer asset which group members relied on when erratic weather or prolonged drought adversely affected crop and livestock production. The VSLAs schemes served as a form of insurance from which members drew funds to support their basic livelihoods assets and provide for basic needs thus withstanding climate change related stocks such as drought**.**

Empirical evidence on the role of diversification as an adaptation strategy is growing. Crop diversification is shown to help farmers deal with droughts and other shocks in Nigeria (Mortimore, & Adams, 2001). In Ethiopia (Di Falco and Chavas 2009), established that income and livelihood diversification helped households deal with weather shocks. In Zimbabwe and Nicaragua (Ersado, 2003, & Macours et al. 2012) observed that diversification was effective in enhancing resilience to climate change shocks and stresses. Several studies have investigated the effects of adaptation strategies in order to stabilize the livelihoods of rural communities. Among these, diversification emerges as an effective strategy to mitigate the impact of extreme events and climate variability and to deal with uncertain agricultural production while maintaining ecosystem functions and income benefits for smallholder farming communities (Newsham, 2009). According to (Kandlinkar, & Risbey, 2000), crop diversification is one of the important adaptation options in agriculture. Crop diversification can serve as an insurance (risk management strategy) against rainfall variability as different crops are affected differently. Through the cultivation of more crops, farmers spread the risk of crop failure and increase yield stability overall. Different crops are affected differently by climate events, and

this in turn gives some minimum assured returns for livelihood security (Mary, & Majule, 2009 & Bradshaw et al. 2004). Another common climate change adaptation measure observed in farmers' fields is to grow crops and crop varieties that better cope with the new climatic conditions. Studies show that in several African countries, farmers are increasing cultivation of species that perform well in dry and hot seasons, such as finger millet, sorghum and fonio (Digitaria spp) for cereals, and cowpea for legumes (Schlenker, & Lobell, 2010).Unlocking the potential of smallholder farmers amidst climate change is complex, requiring; consideration of critical components including among others: livelihoods diversification, soil health, water conservation, institutional capacity at various levels; national and local levels that is in position to champion the processes inherent in adaptation (Adhikar, *et al.*, 2015). It is also emerging that a greater attention to the understanding, articulating and where it is inevitable providing rebuttal to the paradigms such as the market-led model that is creating an altered marginalization of smallholder farmers in sub- Saharan Africa (Rajaonarison, 2014).

4.4.4 Policy Interventions

The extent of consequences resulting from natural hazard events is strongly influenced by the behaviour of the population in endangered areas and by the duties of local authorities with respect to implementation of disaster risk reduction policies. The interaction between the legal policy framework, the possibilities of risk transfer, and raising awareness is essential for efficient disaster risk reduction and contributes to the concept of resilience as part of proactive adaptation. Risk awareness is not very prevalent throughout the country due to an information deficit related to the general occurrence of climate change hazards and mitigation strategies and concepts to avoid losses. The study revealed that project interventions had contributed to raising awareness on existing disaster risk reduction and climate change adaptation related

policies. Moderate number of the respondents (60 percent) reported to have been sensitized on disaster risk reduction and climate change related policies (Table 23).

The study sought to gauge the Level of awareness created about disaster risk reduction by RELI program (Table 23).

It has been observed that losses caused by natural hazards have been continuously increasing despite the concurrently growing volume of research on natural risks highlighting the gap between what is known about natural hazards and disaster mitigation being translated into disaster risk reduction (DRR) policies and programmes (Zia A., & Wagner C.H., 2015). Awareness is the key element for reducing disasters caused by natural hazards including landslides and achieving human security in the pursuit of sustainable development. Past experience, projects, and programs have revealed enormously positive effects of awareness and education for vulnerability reduction and disaster risk management. Children and adults who know how to react in case of a disaster, community leaders who have learned to warn their people in time, and whole social layers who have been taught how to prepare themselves for natural hazards have contributed to better mitigation strategies and dissemination of information on the dangers of hazards. Education and knowledge have provided people with tools for vulnerability reduction and life-improving self-help strategies. Furthermore, more stable and disaster resilient education facilities, such as school buildings, provide a shelter in case of hazards and must be strengthened and improved through better engineering and technical knowledge.

Awareness raising also plays a substantial role in improving risk assessment procedures in nearby communities, in encouraging people to engage in building up resiliency and to generally reduce risk elements in communities (Gaillard & Mercer 2013). For education and awareness on risk reduction to have its desired impact on communities, it needs to reach out to the remotest

development worker in the field. Such education needs to be made accessible and affordable for frontline practitioners who operate at community level and are often far removed from conventional knowledge centres such as universities.

Level of disaster risk reduction awareness and preparedness

The environmental and socio-economic interventions were combined with training on awareness raising to contribute to household and community level resilience.The study sought to gauge the level of community preparedness to respond to climate change shocks/stresses.

Table 23: Level of disaster risk reduction awareness

Sensitised on disaster risk reduction and climate change adaptation policies	Frequency (N=220)	Percentage
Yes	132	60
No	88	40

Source: Field Data

The study revealed that 60 percent of the respondents had been sensitized about disaster risk reduction (Table 23). In view of the level of awareness on disaster risk reduction and climate change adaptation policies created in the community the study sought to establish how this had been translated into actual disaster risk reduction. The respondents were asked to score the state of preparedness of the community for the drought, crop pests, livestock diseases, floods and conflicts on a scale of 1 to 10: 1 being completely unprepared and 10 being completely prepared.

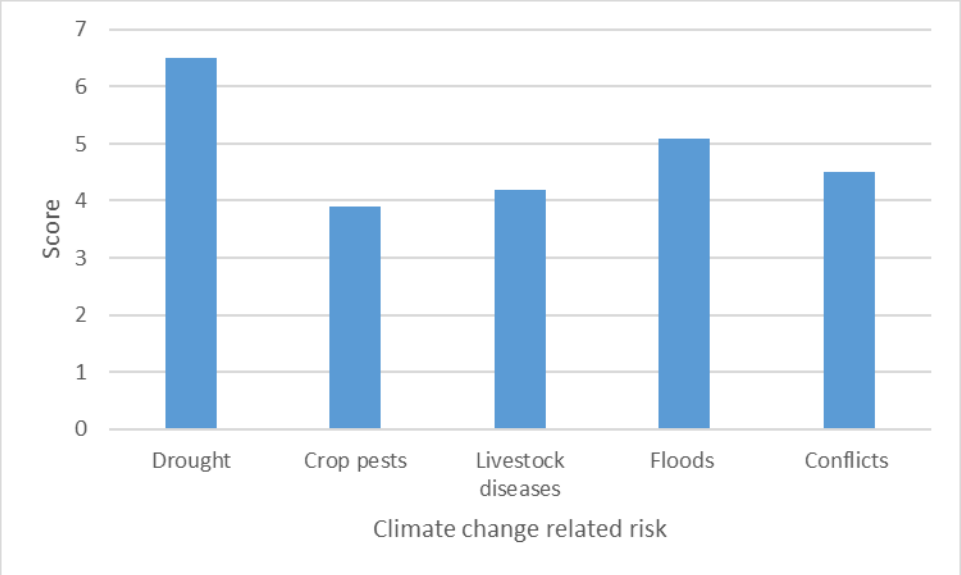

Figure 13: Respondents' perceptions of community preparedness

Source: Field Data

The study revealed that drought preparedness had the highest score (average of 6.5) compared with preparedness for floods (average score of 5.1)). Respondents felt that the community was least prepared for crop pests and livestock disease together with conflicts with an average score of less than 5 (Figure 13). The findings provide an indication of the state of preparedness for these climate shocks attributed to RELI programme intervention on raising disaster risk reduction awareness.

Makueni had enacted County Climate Change Policy Fund regulation which offers a window of opportunity for effective coordination of climate change adaptation and risk reduction actions. As such, there is need therefore for development actors to establish clear strategies for awareness raising on how the regulation can spur disaster risk reduction and climate change adaptation actions. This is because the regulation has established an institutional framework to coordinate and manage implementation of disaster risk reduction and climate change adaptation actions. This is attributed to the emerging community policy dialogue between the citizens and county government

According to the RELI Programme Project Officer integrating climate change policy influence as part of project implementation helped to establish sustainable and long-term solutions to climate related shocks to the vulnerable communities. The ensuing enabling policy environment will continue to spur communities to hold the county and national government accountable in providing both technical and financial support to address the common climate related shocks experienced locally. The project was implemented under unique governance circumstances, when Kenya was transitioning from a centralised to a devolved system of governance after the promulgation of a new constitution in 2010. In the new system, the country is now governed at two levels by the national government and 47 county governments. The law provides for shared responsibility between the national and county governments in dealing with climate related shocks (GOK, 2016). Climate related shocks presents challenges to achieving the development aspirations of the country. Indeed, small incremental changes to existing policies and approaches may not be sufficient and risk maintaining the status quo, where some groups and communities remain marginalised and where narratives of unproductivity and vulnerability still dominate. National governments and development partners need to create space within policy and financial interventions to work with communities. Further on policies and institutions the governments should explicitly target the needs of the broad range of community members in the ASALs in their County Integrated Development (CIDP) and sector Annual Development (ADP). Projects implementation strategy should explore entry in the structures of the county government to effect advocacy within the county governments. Equally, CSOs need to aggressively advocate for inclusion of disaster risk reduction and climate change issues in the CIDPs and other county level plans.

4.5. Challenges Inhibiting Households from Developing Resilience to Climate Change Related Shocks

The study sought to establish challenges inhibiting households from developing resilience to climate change shocks/stresses (Table 24).

Table 24: Factors inhibiting households from adapting to climate shocks

Inhibiting factors	**Frequency of respondents (N=220)**		**Percentage**	
	Yes	No	Yes	No
Lack of information	79	141	35.9	64.1
Poor development infrastructure	24	196	10.9	89.1
Lack of financial resources	196	24	89.1	10.9
Institutional barriers	79	141	35.9	64.1
Technology barriers	88	132	40	60

Source: Field Data

The study revealed that of all the factors that inhibit households from adapting to climate change lack of information, poor development infrastructure, lack of financial resources institutional barriers, and technology barriers accounted for 35.9 percent, 10.9 percent, 89.1 percent, 35.9 percent and 40 percent respectively (Table 24). FGD participants reported that adapting to climate change related shocks required financial investments to implement interventions which were out of reach for poor households. Further key informant interviews revealed that some of the interventions were resource intensive. According to the FGD participants some of the available adaptation technologies were labour intensive and cost more which was an inhibiting factor for adoption. The key informant interviews revealed that institutional barriers at individual and organizational levels influence mainstreaming of

adaptation strategies. For instance, funding for adaptation strategies is dependent on how well climate change is mainstreamed in the annual sector development programme plans derived from the County Integrated Development Plan (CIDP).

Communities across the globe are adapting to the impacts of climate change. Particularly in developing countries, there is an important role ascribed to governments to create an enabling policy system that helps the most vulnerable social groups and regions to start adapting (Bardsley, 2015; Ensor & Harvey, 2015). Many examples of governments building this capacity have been recorded, including increasing knowledge exchange, creating training and educational programmes, empowering the poorest and most vulnerable groups, enhancing social networks, and connecting administrative levels and scales. However, planning for climate change adaptation (CCA) in developing countries is considered highly complex as this takes place in a setting of multiple socio-economic and political challenges.

The study revealed that lack of financial resources was by far the most important factor that inhibits households from developing resilience to climate change shocks reported by 89 percent of the respondents. Lack of finance or access to credit was a significant barrier to climate change adaptation (Bryan, *et al.*, 2011). Further (Gbetibouo, 2009) in a study in the Limpopo Basin, South Africa cited lack of access to credit and lack of savings as the main barriers to adapting to climate change. Lack of funds and access to capital is a barrier (Crick *et al.*, 2018). Currently, informal enterprises and those with more restricted access to formal land ownership, including women, mobile pastoralists and other producers whose farmland is either communally owned or allocated through informal tenure, often struggle to access credit through formal channels (Carabine *et al*., 2018). Even among formal enterprises, climate and business development finance opportunities are often limited. While microenterprises may be able to access finance through microfinance initiatives, and larger enterprises find it easier to

access bank loans, these credit sources are often suited to the more established, leaving vulnerable, enterprises that fall outside of micro-industry and within the larger 'small' and 'medium' enterprise classifications. This often creates a 'missing middle' when it comes to accessing finance for businesses (World Bank, 2007). Lack of access to general government business support and specific adaptation assistance also decreases the probability of sustainable adaptation action (Crick *et al*., 2018). Technology barriers were identified as another key factor inhibiting households from developing resilience to climate change as reported by 40 percent of the respondents (Table 24). Lack of information about adaptation options, as well as lack of data developed at the right temporal and spatial scales and climate information services targeted to the specific needs of users are also critical barriers (Kenya Meteorological Department, 2017). Adaptive capacity is also often restricted through limited access to markets and technologies, including climate-smart technologies and inputs (those that are better suited to a changing climate). There are also institutional barriers stemming, for example, from lack of coordination between sectors and policies. The ability of households and the community to adapt to climate shocks is also shaped by wider social vulnerabilities and structural inequalities that constrain opportunities and freedoms. Multidimensional inequalities around gender, age, political identity, geographical location, economic activities, income and assets can all limit adaptive capacity (Davies, 2018). Women typically face additional barriers, including more limited access to land, finance, educational opportunities and other assets (Batool, & Saeed, 2017). Those that are hardest hit are often least able to absorb and recover from shocks, leaving the poorest and most vulnerable even less able to cope in the future (GOK,2018). Unmanaged climate related shock impacts therefore have strong potential to perpetuate and worsen existing socioeconomic inequalities among households and communities in ASALs representing a direct threat to achieving Kenya development blueprint of vision 2030 (GOK, 2016). Some of the barriers identified are those that result from the shortcomings of the society at large. In this

sense therefore, they are not within the control of the farm households. The applicable economic theory here is that of externalities and public goods which demands for institutional reforms through policy and legislation actions. Although institutions of the state and civil societies both facilitate adaptation, top down approach have rarely enhanced the legitimacy and built on local solutions. It is critical therefore to identify characteristics of appropriate legal, policy and institutional frameworks through which adaptation measures can be implemented. Especially those that permit evolutionary change and learning to be incorporated, and the role of structural and non-structural characteristics. To identify appropriate characteristics, we can consider the underpinning of institutional theory. Governance, the structures and processes by which societies share power, shapes individual and collective actions and can be formally institutionalized or expressed through subtle norms of interaction. Both influence the agenda that support adaptation

Hierarchical policy system and capacity in Vietnam at different levels of government has worked well to enable policy actors to help local actors to adapt to climate change impacts. Over the past decades, the Vietnamese government has already implemented several climate change adaptation and disaster risk reduction activities, policies, and strategies (Hoang et al., 2014) in a formalized and top-down manner to ensure timely actions (Rubin, 2014). In Vietnam, the policy systems are characterized as 'bureaucratic hierarchies', 'administrative states', or a 'mono-centric modes of governance' (Schreurs, 2010). In these systems, the focus is on the centre of political power and authority – the state – that sets the agenda of societal problems, decides upon policy goals and means, and implements its policies at lower administrative levels in a top-down manner (Schreurs, 2010). Vietnam has organised to respond to climate change through a structure characterized by the specialization of functions, objective qualifications, civil servants who follow a fixed set of rules, and a hierarchy. The presence of decentralised institutions coordinating the implementation of the national climate

change strategy and action plan at national and province level is helpful as it clarifies roles, tasks, and responsibilities of policy and societal actors (Schreurs, 2010) The fact that adaptation is not the sole responsibility of one ministry but rather shared across multiple ministries is considered to be strength, as it ensures that mainstreaming adaptation across vulnerable sectors is ensured. Consequently, at the national level, several policy networks and collaborations have emerged to share information and encourage policy learning for implementing across different sectors. Second, because adaptation at subnational levels is mainstreamed in annual and five year social-economic development plans (SEDPs) there is increasing institutionalized support for staff at province, district, and commune levels. This allows each level to gradually increase their governing resources and analytical capacity of their policy actors. Further hierarchical and structured approach ensures some degree of consistency and coherence between sectors (horizontal) and across all levels (vertical) in how to frame and address climate change related impacts.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

A summary of findings, conclusion, recommendations, and likely research areas are highlighted in this chapter. They are provided in line with the set study objectives. The main objective of the study was to examine the extent to which the resilient livelihoods project implemented in Kalawani Location; Mbooni Sub-County of Makueni County had contributed to strengthening resilience of the households to climate change related shocks.

5.1 Summary

The first specific objective of the study was to examine how climate related shocks and stresses contribute to making the people more vulnerable in Kalawani Location. The study revealed that drought, crop pests, livestock diseases, resource-based conflicts and flooding were the main climate change shocks/stresses experienced in the study site. The climate change shocks/stresses are increasing in frequency and scale impacting negatively on livelihoods of households and community that is largely dependent natural resources for their livelihood. The shocks/stresses were characterised by increased episodes of prolonged droughts, increased temperature and heat stress, reduced and erratic rainfall patterns over space and time. This triggered major environmental, social and economic disruptions especially on crop and livestock production the economic mainstay of the households and the community. Between 2005 and 2013 the entire Makueni County including the study site experienced four incidences of prolonged droughts. This is corroborated by time series analysis of rainfall and temperature trends for the period between 1985 and 2010 which indicates that the study site has experienced more years of less than average rainfall and more years of higher than average temperatures. The actual observed temperature trends indicate significant warming over the past one century

with an increase of almost 1^0 C. The meteorological data indicated that the County had experienced more years of unfavourable climatic conditions of high temperatures and reducing rainfall with the mean annual rainfall reducing from 750mm to 550 mm between the year 1900 and 2000 indicating a negative trend. Most of the respondents (90%) indicate that the onset of rain, which marks the end of the dry season, is increasingly coming late while 95% were of the opinion that the rains stopped early. These are characteristics of drought. Prolonged drought caused crop failure and stunted growth reported by 70 percent and 90 percent of the respondents respectively. Similarly, 93 percent and 91 percent of the respondents' reported that drought led to reduced feed availability and livestock productivity respectively. Increased incidents of crop pests and livestock diseases were the other climate change related shocks/stresses reported by 78 per cent and 46 per cent of the respondents respectively. The seasonal trend analysis of reported incidents of conflicts at the Chief's camp for a period of three years between 2012 and 2014 revealed an upsurge of conflicts which coincided with periods of prolonged drought. Further the study revealed that loss of crops and income as main effect of flooding as a shock reported by 71 per cent and 63 per cent of the respondents respectively. The intersection of the shocks/stresses and severe impacts resulting from their increased frequency and intensity deepened people's vulnerability resulting to a pattern of repeated humanitarian crisis.

The second specific objective of the study was to analyse how RELI programme achievements contributed to increasing the community's capacity to respond to climate shocks/stresses in Kalawani Location. The study revealed that RELI Programme supported the community and the households to implement several adaptation and resilience strengthening interventions in response to drought and other climate change related shocks/stresses. The adaptation interventions supported by RELI programme were in three broad categories namely, environmental, socio-economic and policy. In the environmental category of interventions RELI programme supported households to adopt and implement various drought and other

climate related shocks mitigation activities like rain water harvesting, small scale irrigation agriculture, use of cover crops, use of grass strips terracing and contour farming, soil bunds and mulching achieving and adopt rate of an average of 58 percent. In the socio-economic categories the programme supported households to adopt and implement various drought and other climate related shocks mitigation activities like intercropping, kitchen gardening, mixed farming, agroforestry, and growing new improved crop varieties achieving an adoption rate of an average of 60 percent. Further RELI programme introduced VSL as a socio-economic intervention which brought financial services to the community where access to formal financial services was typically very limited. Over a period of eight months 2016 total cumulative shares were Kshs. 19,771,825 and total cumulative loans were Kshs. 35,589, 285 for the 22 groups in the sample. A range of soil fertility management practices, including use of farmyard manure and compost manure had been developed and applied by households with support from RELI programme. An average 25 percent of the households were involved in one or more of the following soil fertility management practices: use of compost manure, green manure, backyard manure, and inorganic fertilizers. These soil fertility management practices are known to enhance soil resilience by improving the soil structure and texture, organic matter, nutrient dynamics, soil organisms and cation exchange capacity that collectively enhance soil productivity in the face of climate change shocks/stresses. Further RELI programme promoted creating awareness and educating households reaching 60% of the population in encouraging people to engage in building up resiliency and to generally reduce risk elements. Resulting the level of preparedness to the climate change shocks/stresses common in Kalawani location namely: drought, crop pests, livestock diseases, conflicts and flooding had increased. The respondents were asked to score the state of preparedness for each of the climate related shocks/stresses on a scale of 1 to 10: 1 being completely unprepared and 10 being completely prepared. The study revealed that drought preparedness had the highest score of 6.5 compared

with preparedness for floods with a score of 5.1. Respondents felt that the community was least prepared for crop pests and livestock disease together with conflicts with an average score of less than 5. The findings provide an indication of the state of preparedness for these climate shocks attributed to RELI programme intervention on raising disaster risk reduction awareness.

The third specific objective of the study was to identify challenges inhibiting households from developing resilience to climate related risks in Kalawani Location. The study revealed that of all the factors that inhibit households from adapting to climate change lack of information, poor development infrastructure, lack of financial resources institutional barriers, and technology barriers accounted for 35.9 percent, 10.9 percent, 89.1 percent, 35.9 percent and 40 percent respectively.

Among all the soil moisture conservation and management programme interventions adopted by the households' 8.1 percent, 19.3 percent, 18.1 percent, 10.8 percent, 19.1 per cent, 18.5 percent and 6.1 percent were grass trips, soil bunds, terracing/contour framing, cover crops, small scale irrigation agriculture, rain water harvesting and mulching respectively. The study also revealed that among all the soil fertility management practice interventions adopted, 30,9 percent, 27.7 percent,26.4 per cent and 15 percent were compost manure, backyard manure, inorganic fertilizers and green manure respectively. Further the study revealed that households had adopted livelihoods diversification practices of intercropping, kitchen gardening, mixed farming, agroforestry and use of new crop varieties at a level of 28.5 percent, 14.9 percent, 24.8 percent, 17.9 percent and 13.9 percent respectively. Other RELI programme interventions contributing to enhanced capacity of the households and the community to respond to climate change were VSALs and awareness raising on climate shocks/stress disaster risk reduction. Owing to the level of adoption there is demonstrable evidence of progress towards

strengthening household and community resilience to drought and other climate change related shocks.

Lastly the study revealed that of all the factors that inhibit households from adapting to climate change lack of information, poor development infrastructure, lack of financial resources institutional barriers, and technology barriers accounted for 16.9 percent, 5.4 percent, 42 percent, 16.9 percent and 18,8 percent respectively

5.2 Conclusion

The study concluded that drought is the major climate related shock in Kalawani because it is directly linked to the other shocks. It is manifested in increasingly higher temperatures and reducing rainfall that led to an increase in crop pest and livestock disease making agriculture a risky undertaking yet 80.9 percent of the respondents derived their livelihood from it. The project interventions addressing drought had an adoption rate of 58% which is above average, and this can be used as a proxy indicator for improvement in their capacity to respond to drought. Finance was cited as the greatest challenge inhibiting households from developing resilience to climate related shocks. RELI introduced VSL as a socio-economic intervention which brought financial services to the community where access to formal financial services was typically very limited. Over a period of eight months 2016 total cumulative shares were Kshs. 19,771,825 and total cumulative loans were Kshs. 35,589, 285 for the 22 groups in the sample. The project also improved their capacity by promoting diversification of on farm activities which achieved an adoption rate of 60 percent.

The study has shown that RELI programme largely managed to strengthen the capacity of the households and the community to effectively respond to shocks/stresses by promoting the adoption of sustainable adaptive strategies. Taking the resilience theory which views resilience as a process and not an outcome in the face of adversity, this study concludes that the

beneficiary households are making progress towards the trajectory to achieving resilience. All the households adopted at least one of the adaptation technologies supported by the programme which is promising progress towards resilience.

5.3 Recommendations

Given the high vulnerability of rural communities in the ASALs to climate shocks/stresses, it is essential to build resilience to climate change of the rural livelihood systems through the adoption of sustainable adaptive strategies. It is important to acknowledge the need for a multi-level approach to assessing resilience responses to climate change shocks/stresses put in place by individual households, communities or even societies. Current resilience assessment practices as was the case for the study on RELI programme focus on targeted households and communities of the interventions. However, the ultimate effect of a shock or stress on the targeted population does not depend only on their response. Rather, the effect of a shock or stress on target population also depends on how other non-direct beneficiary actors respond to the shock or stress at local, ward, county and national levels. To accelerate the adoption of adaptation actions and sustain the achievements of resilience programmes it is imperative to address the identified challenges that may inhibit households and communities from developing resilience to climate change shocks/stresses.

5.4. Research opportunities

The study has elucidated various challenges inhibiting the households and the community from developing resilience to climate change shocks/stresses. The challenges manifest as difficulties in promoting adoption of adaptation strategies and need to be addressed to sustain strengthening resilience to climate change shocks/stresses.Taking cognizance of the fact that shocks/stresses and trends affect not only individual households and communities but also

institutions, and governance systems further research is required to interrogate the layered link in relationship to mutually reinforcing response interventions or absence of the same across the different levels in resilience programmes assessment. Applying the concept of resilience as a process with aim to maintain or improve wellbeing in the face of climate shocks/stresses calls for further research linking process to the outcomes of wellbeing.

REFERENCES

Adager, W. N., Brown, K., Nelson, D. R., Berkes, F., Eakin, H., Folke, C., Galvin K., Gunderson L., Goulden M., O'Brien K., Ruitenbeek J., & Tompkins E. L. (2011). Resilience implications of policy responses to climate change adaptation at scale in semi-arid regions Project.

Adger, W. N. (2011). Resilience implications of policy responses to climate change.

Adhikari, U., Nejadhashemi, A. P., & Woznicki, S. A. (2015). Climate change and eastern Africa: A review of impact on major crops. Food and Energy Security

AEA Group, (2008). Kenya climate screening and information exchange.

Aich, V., Koné, B., Hattermann, F. F., & Müller, E. N. (2014). Floods in the Niger Basinanalysis and attribution.

Alexander, d. E. (2013). Resilience and disaster risk reduction: an etymological journey

Alinovi, L., D'Errico, M., Mane E., & Romano D. (2011). Livelihoods strategies and household resilience to food insecurity: An empirical analysis to Kenya

Altizer, S., Bartel, R., & Han, B. A. (2011). Animal migration and infectious disease risk science.

Archer, E., Dziba, L., Mulongoy, K. J., Maoela, M. A., & Walters, M. (2018). Summary for policymakers of the regional assessment report on biodiversity and ecosystem services for Africa of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.

Armah, A. (2010). Impact of Floods on Livelihoods and Vulnerability of Natural Resource Dependent Communities in Northern Ghana.

Bahadur, A. V., Ibrahim, M., & Tanner, T. (2013). Characterising resilience: unpacking the concept of tackling climate change and development.

Bahadur, A., Peters, K., Wilkinson, E., Pichon, F., Gray, K., and Tanner, T. (2015) The 3As: Tracking resilience across BRACED.

Bardsley, D. K. (2015). Navigating the roles of the social learning researcher: A critical analysis of a learning approach to guide climate change adaptation.

Batool, S., & Saeed, F. (2017). Mapping the cotton value chain in Pakistan: A preliminary assessment for identification of climate vulnerabilities & pathways to adaptation. PRISE Working Paper.

Béné C., Wood R. G., Newsham A., Davies M. (2013). Resilience: New utopia or new tyranny? Reflection about the potentials and limits of the concept of resilience in relation to vulnerability reduction programmes.

Bennett, N.S. (2009). The influence of caste, class and gender in surviving multiple disasters: A case study from Orissa, India. Environmental Hazards. Retrieved from https://www.researchgate.net// July 12,2017.

Berger, R., (2003). Conflict over natural resources among Pastoralists in Northern Kenya: a look at recent initiatives in conflict resolution.

Berkes, F., Colding, J., Folke, C. (2002). Navigating socio-ecological systems: Building resilience for complexity and change.

Bett, B. (2016). Risk analysis and risk mapping for transboundary animal diseases.

Boko, M., Niang, I., Nyong, A., & Vogel C. (2007). Impacts, adaptation and vulnerability: Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.

Brand, F. S., & Jax, K. (2007). Focusing the meaning(s) of resilience: Resilience as a descriptive concept and a boundary object.

Brecht, H., Dasgupta, S., Laplante, B., Murray S., & Wheeler D. (2012). Sea-level rise and storm surges: high stakes for a small number of developing countries.

Brida, A. B., Owiyo, T., Sokona, Y., (2013). Loss and damage from the double blow of flood and drought in Mozambique

Brown, S. (2014). Safe and just operating spaces for regional social-ecological systems

Bryan, E., Ringler, C., Okoba, B., Roncoli, C., Silvestri, S., & Herrero M. (2011): Adapting Agriculture to Climate Change in Kenya: Household and Community Strategies Determinants.

Cannon, T., & Muller-Mahn, D. (2010). Vulnerability, resilience and development discourses in context of climate change, Natural Hazards.

Carabine, E., & Simonet C. (2018). Value Chain Analysis for Resilience in Drylands: Identification of adaptation options in key sectors. PRISE Working Paper (forthcoming). Retrieved from https://www.odi.org// January 6, 2018.

Chambers, R. (2013). Participatory Governance and Institutional Change

Cheke, R. A., & Tratalos, J. A. (2007). Migration, patchiness and population processes illustrated by two migrant pests. Bioscience.

Chronic Poverty Research Centre (2008). The chronic poverty Report 2008/2009

Chronic Poverty Research Centre (CPRC), (2008). The chronic poverty report 2008/2009: Escaping poverty traps.

Coakley, S., Scherm, H., Chakraborty, S. (1999). Climate change and plant disease management. Annual Review of Phytopathology.

Cooper, S. J., Wheeler, T. (2015). Adaptive governance: Livelihood innovation for climate resilience in Uganda.

Costella, C., & Weingarten L. (2019). Linking financial services and social protection for resilience: Lessons from Kenya.

County Government of Isiolo (2014). Isiolo County Integrated Development Plan 2013-2017.

Crick, F., Eskander, S., Fankhauser, S., & Diop, M. (2018). How do African SMEs respond to climate risks? Evidence from Kenya and Senegal.

Daron, J.D. (2014). Regional climate messages: East Africa, scientific report from the CARIAA

Dasgupta, S., Laplante, B., Murray, S., & Wheeler, D. (2011). Exposure of developing countries to sea-level rise and storm surges. Retrieved from https://link.springer.com// January 17, 2017.

Davies, J. (2018). Barriers and enablers to climate change adaptation in North - Central Namibia.

Dekens, J., Parry, J., Zamudio, A., & Echeverría, D. (2011). Climate risk management for Malaria Control in Kenya.

Di Falco, S., & Chavas J.P. (2009). Crop biodiversity, risk exposure, and food security in the highlands of Ethiopia.

Eckstein, D., Kunzel, V., & Schafer, L. (2017). Global climate risk Index 2018: Who suffers most?

Elasha, O. B. (2015). Climate Change in Africa, there is hope, it is not all gloomy.

Emergency Events Database (2015). The International Disaster Database, Brussels: Centre for Research on the Epidemiology of Disasters, University of Louvain.

Ensor, J., & Harvey B. (2015). Social learning and climate change adaptation: Evidence for international development practice.

Ersado, L. (2003). Income diversification in Zimbabwe: Welfare implications from Urban and Rural Areas. FCND Discussion Paper No. 152. International Food Policy Research Institute. Food Consumption and Nutrition Division.

Evans, N., Baierl, A., Semenov, M. A., Gladders, P., & Fitt, B. D. L. (2008). Range and severity of a plant disease increased by global warming. Journal of Royal Society Interface.

FAO, (2016). The future of food and agriculture Trends and challenges.

Fajer, E. D., Bowers, M. D., & Bazzaz, F. A. (1989). The effect of enriched CO2 atmospheres on plant insect herbivore interactions.

Folke, C. (2006). Resilience: The Emergence of a perspective for socio-ecological systems analysis.

Frankenberger, T., Spangler, T., Nelson, S., Langworthy M., (2012). Enhancing resilience to food security Shocks in Africa from Extreme Weather Events.

Funk, C., Michaelsen, J., & Marshall, M. (2012). Mapping recent decadal climate variations in precipitation and temperature across Eastern Africa and the Sahel. In remote sensing of drought—innovative monitoring approaches.

Fussel, H. M. (2007). Adaptation Planning for Climate Change: Concepts, Assessment Approaches, and Key Lessons. Retrieved from http://www.scirp.org// December 17, 2017.

Gaillard, J.C., & Mercer, J., (2013). From knowledge to action: Bridging gaps in disaster risk reduction.

Gbetibouo, G. A. (2009). Understanding Farmers perceptions and adaptations to climate change and variability: The case of the Limpopo Basin farmers South Africa. Retrieved from http://www.ifpri.org// December,17 2017.

Gil, J. D. B. (2017). The resilience of integrated agricultural systems to climate change

Gornall, J., Betts, R., Burke, E., Clark, R., Camp, J., Willett, K., et al. (2010). Implications of climate change for agricultural productivity in the early twenty first century.

Government of the Republic Kenya (2016). Climate Change Act, 2016. Government printer.

Government of the Republic of Kenya (2010). National Climate Change Response Strategy. Government printer.

Government of the Republic of Kenya (2016). Addressing Climate Change: Success Stories from Kenya. Nairobi: Ministry of Environment and Natural Resources.

Government of the Republic of Kenya (2017). The 2017 long rains season assessment report. Kenya Food Security Steering Group.

Government of the Republic of Kenya (2018). National Climate Change Action Plan 2018-2022. Government printer.

Gregory, P. J., Johnson, S. N., Newton, A. C., & Ingram J. S. I. (2009). Integrating pests and pathogens into the climate change/food security debate.

Hager, A.L. (2007). Possible impact of climate change on livestock production in Namibia.

Haile, G. G., Tang, Q., Sun, S., Huang, Z., Zhang, X., & Liu, X. (2019). Droughts in East Africa: Causes, impacts and resilience.

Halsnaes, K., & Traerup, S. (2009). Development and Climate Change: A Mainstreaming Approach for Assessing Economic, Social, and Environmental Impacts of Adaptation Measures. Retrieved from https://link.springer.com// December 17, 2017.

Hamidov, A., Helming, K. (2020). Sustainability Considerations in Water–Energy–Food Nexus Research in Irrigated Agriculture

Hinkel, J., Brown, S., Exner, L., Nicholls R. J., Vafeidis, A.T., & Kebede A.S. (2011). Sea-level rise impacts on Africa and the effects of mitigation and adaptation. Retrieved from https://eprints.soton.ac.uk// May 2, 2018

Hoang, M., Namirembe, S., Van-Noordwijk, M., Catacutan, D., Öborn, I., Perez-Teran A., et al. (2014). Are trees buffering ecosystems and livelihoods in agricultural landscapes of the Lower Mekong Basin? Consequences for climate-change adaptation.

Holing, C. S. (1996). Engineering resilience versus ecological resilience.

Holling, C. S. (1973). Resilience and stability of ecological systems.

Hugo, H. R., Runion, G.B., Krupa, S. V. (1994). Plant responses to atmospheric CO2 enrichment with emphasis on roots and the rhizosphere

Inter-Agency Standing Committee on Humanitarian Assistance (2011). Operational Guidelines on Human Rights and Natural Disasters.

Intergovernmental Panel on Climate Change (2001). Climate Change: The scientific basics

Inter-governmental Panel on Climate Change (2007). Fourth Assessment Report: Retrieved from http://www.ipcc.ch/ May 21, 2018.

Inter-governmental Panel on Climate Change (2014). Fifth Assessment Report. Retrieved from https://www.ipcc.ch/ March 21, 2018.

Inter-governmental Panel on Climate Change (2018). Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.

International Centre for Tropical Agriculture Kenya (2016). County climate risk profile series report.

International Development Institute (2011). Sustainable livelihoods and livelihood diversification.

International Food Policy Research Institute (2017). Global food policy report.

International Fund for Agricultural Development (2017). Annual Report. Retrieved from https://www.ifad.org/ May 25, 2018.

Jones, L., & Tanner T. (2015). Measuring 'Subjective Resilience': Using peoples' perceptions to quantify household resilience.

Kandlinkar, M., & Risbey J. (2000). Agricultural impacts of climate change: If adaptation is the answer, what is the question? Retrieved from https://www.researchgate.net// May 25, 2018.

Karuku, G. N. (2018). Soil and water conservation measures and challenges in Kenya

Kenya Institute for Public Policy Research and Analysis (2018). Economic and social implications of drought and floods in Kenya.

Kenya Meteorological Department (2017). Climate change risks analysis Report.

Kenya National Bureau of Statistics (2018). Economic survey report.

Kloos, J. (2014). Divergent adaptation to climate variability: A case study of pastoral and agricultural societies in Niger. Global Environmental Change 29, pp. 371–386.

Le Meur, P., Hochet, P., Martin S., Touré O. (2006). Conflict over access to land & water resources within sub-Saharan dry lands: Underlying factors, conflict dynamics and settlement processes.

Lim, B., Spanger-Siegfried E., Burton I., Malone E., Huq S. (2005). Adaptation policy frameworks for climate change: Developing strategies, policies and measures. Retrieved from https://www.preventionweb.net// January 3, 2017.

Lovell, E., Twigg, J., & Lungahi G. (2019). Building resilience for all: Intersectional approaches for reducing vulnerability to natural hazards in Nepal and Kenya.

Macours, K., Premand, P., & Vakis R. (2012). Transfers, diversification and household risk strategies: experimental evidence with lessons for climate change adaptation. Policy Research Working Paper 6053, Washington, DC, World Bank.

Mariner, J., & Paskin N. (2013). World Livestock: Changing Disease Landscape. Retrieved from http://scholar.google.com// December 12, 2018.

Mary, A. L., & Majule A. E. (2009). Impacts of climate change, variability and adaptation strategies on agriculture in semi-arid areas of Tanzania: The case of Manyoni District in Singida Region, Tanzania. African Journal of Environmental Science and Technology.

Masih, I., Maskey, S., Mussa, F. E. F.., Trambauer, P., (2014). A review of droughts on the African continent: a geospatial and long-term perspective.

Mbow, C., Smith, P., Skole, D., & Duguma, L. (2014). Achieving mitigation and adaptation to climate change through sustainable agroforestry practices in Africa. Retrieved from https://www.sciencedirect.com// December 13, 2017.

Mitchell, T., & Tanner, T.M. (2006). Adapting to Climate Change: Challenges and Opportunities for Community Development. Retrieved from https://www.ids.ac.uk// December 13, 2017.

Mortimore, M.J., & Adams, W.M. (2001). Farmer adaptation change and crisis in the Sahel. Global Environmental Change. Retrieved from https://www.gov.uk// December 13, 2017.

Morton, J. (2001). Pastoralism, Drought and Planning. Lessons from Northern Kenya and Elsewhere.

Morton, J. (2006). Policy options paper: community-based drought management for the pastoral livestock sector in Sub-Saharan Africa. Retrieved from http://documents.worldbank.org/ / December 13, 2017.

Moru, E., (2010). 'Adaptation to Climate Variability among the dry land population in Kenya. A case study of the Turkana Pastoralists'. MSc Thesis Wageningen University, Netherlands.

Mugwe, J., Ngetich, F.K., & Otieno E. (2019). Integrated Soil Fertility Management in Sub-Saharan Africa: Evolving Paradigms Toward Integration.

Murphy, D., & Chirchir, D. (2017). Kenya County Integrated Development Plans (CIDPs) 2013-2017: Review of Climate Change Mainstreaming.

Mutimba, S., Mayieko, S., Olum, P., & Wanyama K. (2010). Climate Change Vulnerability and Adaptation Preparedness in Kenya. Nairobi, Kenya: Retrieved from http://www.boell.or.ke/ February 9, 2018.

Mwenda, S.M., Mugambe, A., & Nyaga, J. (2016). Desertification as an impact of Climate Change

Nangombe, S. S., Zhou, T., Zhang, W., Wu, B., Liwei, Z., Shuai, H., et al., (2018). Record-breaking climate extremes in Africa under stabilized 1.5 °C and 2 °C global warming scenarios.

Neuman, J., Emanuel, K. A., Ravela, S., Ludwig, L. C., & Verly C. (2013). Assessing the risk of cyclone-induced storm surge and sea level rise in Mozambique. Retrieved from https://www.wider.unu.edu/ December 17, 2017.

Newsham, A., & Thomas D. (2009). Agricultural Adaptation, Local Knowledge and Livelihoods Diversification in North-Central Namibia.

Ngigi, M., Haglund, E., Birner, R. Aberman, N., Ali, S., & Alemu T., (2015). Understanding the policy landscape for climate change adaptation: A Cross-Country comparison using the Net-Map method.

Niang, I., Ruppel, O. C., Abdrabo, M. A., Essel A., Lennard, C., Padgham, J., et al.& P., (2014). Impacts, adaptation, and vulnerability.

Niang, I., Ruppel, O.C., Abdrabo, M.A., Essel, A., Lennard, C., Padgham J., et al. (2019). Gendered vulnerabilities to climate change: insights from the semi-arid regions of Africa and Asia.

Oddsdóttir, F., Lucas, B., & Combaz, E., (2013). Measuring disaster resilience

Okello, D., Aketch, J., & Muliro, A., (2005). Towards a common resource Agenda: Resource conflicts in East and Southern Africa

Organisation for Economic Co-operation and Development (2006). Declaration on integrating climate change adaptation into development co-operation adopted by development and environment Ministers of OECD Member Countries. Retrieved from https://www.oecd.org/ December 3, 2018.

Opondo, D. O., (2013). Erosive coping after the 2011 floods in Kenya

Orindi, V., & Murray, L., (2005). Adapting to Climate Change in East Africa: a strategic approach.

Osbahr, H., Twyman, C., Adger, N. W., & Thomas G. S. D., (2008). Evaluating Successful Livelihood Adaptation to Climate Variability and Change in Southern Africa.

Otiende, B., Ochieng, A., Bhadwal, S., Anantram, K., Nair, S., Kumar, V., et al. (2008). Mapping climate vulnerability and poverty in Africa. Report to the Department for International Development, Nairobi, Kenya. Retrieved from https://cgspace.cgiar.org/ December 17, 2017.

OXFAM (2011). A companion guide to resilience

Paavola, J., and Adger, W.N.2006. Fair Adaptation to Climate Change. Retrieved from http://sustainability.psu.edu/ December 17, 2017.

Rajaonarison, H. M. (2014). Food and human security in Sub- Saharan Africa

Reliefweb (2018). Analysis of drought impact in Kenya.

Said, M. Y., Muhwanga, J., Bedelian, C., Carabine, L., Nderitu, S., Moiko, S., et al. (2018). Projected climate change in Kenya ASALs.

Savo, V. et al., 2016: Observations of climate change among subsistence-oriented communities around the world. 59 Nature Climate Change, 6(5), 462-473, doi:10.1038/nclimate2958.

Schipper, L., & Pelling M. (2006. Disaster risk, climate change and international development: Scope for and Challenges to Integration. Retrieved from https://onlinelibrary.wiley.com/ December 15, 2017

Schlenker, W., & Lobell, D. B. (2010). Robust negative impacts of climate change on African agriculture.

Schreurs, M. A. (2010). Multi-level governance and global climate change in East Asia. Asian economic policy.

Sengar, R. S., & Sengar K. (2014). Climate Change Effect on Crop Productivity. Retrieved from http://scholar.google.com/ / October 2, 2017.

Siedenburg, J., Martin, A., & McGuire, S. (2012). The power of "farmer friendly" financial incentives to deliver climate smart agriculture. Retrieved from https://www.tandfonline.com/ May 3, 2018

Staley, J. T., & Johnson, S. N. (2008). Climate change impacts on root herbivores

Stockholm Environment Institute (2009). Economics of Climate Change in Kenya: Final Report submitted in advance of COP15.

Tanner, T., Lewis D., Wrathall, D., Bronen, R., Henry, N. C., Huq, S., et al. (2014). Livelihood Resilience in the face of climate change

Travis, W. R., Waddington, S. R., Anderson, C. L., Chew, A., True, Z. & Cullen A., (2015). Environmental impacts and constraints associated with the production of major food crops in Sub-Saharan Africa and South Asia

Tumbo, S. D., Kahimba, F. C., Mbilinyi, B. P., Rwehumbiza, F. B., Mahoo H.F., Mbungu, W.B., et al. (2005). Impact of projected climate change on agricultural production in Semi-Arid Areas of Tanzania: A Case of Same District. Retrieved from https://www.ajol.info/ December 17,2017

Ungar, M. (2004). Nurturing hidden resilience in troubled youth. University of Toronto Press. Toronto, Canada.

United Nations Development Programme (2007). Human Development Report 2007/2008.

United Nations Development Programme (2007). Human Development Report 2007/2008.

United Nations Development Programme (n.d.). Kenya natural disaster profile. Retrieved from http://mirror.undp.org/kenya/KenyaDisasterProfile.pdf/ October 7, 2018.

Wakhungu, J., (2014, June 7). Mombasa and other coastal islands threatened by sea level rise, cautions CS Judi Wakhungu. The Standard. Retrieved from https://www.standardmedia.co.ke/lifestyle/article/2000123960/

Walker, B., & Salt, David. (2006). Resilience thinking: Sustaining ecosystems and people in a changing world.

Walsh-Dilley, M., Wolford, W., & McCarthy J. (2016). Rights for resilience: food sovereignty, power, and resilience in development practice.

World Bank (2007). Expanding access to finance: Good practices and policies for Micro, Small, and Medium Enterprises. Retrieved from https://openknowledge.worldbank.org// December 17, 2017.

World Bank (2018). Boosting prosperity, improving equity in North and North Eastern Kenya. Retrieved from https://www.worldbank.org/ January 3, 2020

World Health Organization (2018). Climate change and health. Retrieved from https://www.who.int/ June 29, 2019.

World Health Organization (2018). Climate change and health. Retrieved from https://www.who.int/ November 5, 2018.

World Resources Institute (2007). Nature benefits. Retrieved from https://www.wri.org// June 2017

Xu, H., Cai, Z. C., Jia Z. J. & Tsuruta H. 2000. Effect of land management in winter crop season on CH4 emission during the following flooded and rice-growing period. Nutrient Cycling in Agroecosystems. Retrieved from https://link.springer.com/ August 22, 2017.

Yanda, P., Wandiga, S., Kangalawe, R., Opondo, M., Olago, D., Githeko, A., et al. (2006.) Adaptation to climate change/ variability-induced highland Malaria and Cholera in the Lake Victoria. Retrieved from https://www.researchgate.net// August 22, 2017.

Zia, A., & Wagner C. H., (2015). Mainstreaming early warning systems in development and planning processes: Multilevel implementation of Sendai framework in Indus and Sahel.

Zhou, X. L., Harrington, R., Woiwod, I. P., Perry, J. N., Bale, J. S., & Clark S. J., (1995). Effects of temperature on aphid phenology. Retrieved from https://repository.rothamsted.ac.uk//. December 17, 2017.

APPENDICES

Appendix 1: Households Interview Schedule

A. Name of respondent and location information

1	**Name of interviewee**	
2	**Sub-location**	
3	**Village**	

B. Informed Consent

Interviewer to introduce him/herself	
State purpose of the interview	To assess the achievements of RELI Programme in increasing the community' capacity to respond to climate related shocks and stresses in Kalawani location, Makueni county
Seek verbal consent - Proceed if granted/ state why if not	

1.Number of HH members	**Gender**	**Marital status**	**Relationship to head of household**	**Level of education**	**Main source of livelihoods**	**Type of Housing**
1-1-5 members 2-6 members 3-7 members 4-8 members 5-More than 8	1-Female 2-Male	1-Married 2- Widow (er) 3-Single 4- Separated 5-Underage 6-Not Applicable 7-Other(s)-(Specify)	1-Head 2- Spouse 3- Child by Birth 4- Grandchild 5- Other child by relation 6- House help 7- Other(s)- (Specify)	1-Pre-primary 2- Primary incomplete 3- Primary Completed 4-Secondary Incomplete 5- Secondary completed 6-Vocational 7- University 8- Other(s)- (Specify)	1-Farming 2- Petty trade 3- Sand harvesting 4-Charcoal burning 5-Casual labour 6- Salaried 7-Other(s)- (Specify)	1-Permanent 2- Semi-Permanent 3-Makuti/Grass thatched 4- Other(s)-(Specify)

2	How would you describe the onset of the rains at the start of the production season? 1=Late 2=Variable 3=Early 4=Others explain
3	How would you describe the cessation of the rains at the start of the production season? 1=Early 2=Normal 3=Variable 4= Late

4	Which of the following well describes the rainfall distribution for the two seasons of the year MAM and OND? 1=Normal 2= More in the MAM season 3= More in the OND season 4= Mid-season droughts 5= Variable
5	How would you describe temperature changes in the community in the past decade? 1= Lower 2= Moderate 3= Higher 4= Variable
6	What is the effect of drought on your crops? 1. Stunted growth 2. Crop failure 3. Wilting of crops 4. Lack of planting seeds 5. Other(s)- Specify
7	What is the effect of drought on your livestock? 1. Poor livestock body conditions 2. Reduced feed availability 3. Reduced livestock productivity 4. Reduced water availability 5. Livestock death 6. Other(s)- Specify
8	According to your opinion what is the trend of incidences of crop pests and diseases? 1. Increased 2. Normal 3. Decreased 4. Variable
9	How would you describe the type of crop pests and diseases you encounter in farm in the past decade? 1=Rare pest event 2= Common occurrence pests and diseases 3= Evolving pest event
10	What is the effect of floods on your community? 1. Loss of crops 2. Loss of livestock 3. Damage of houses 4. Loss of household items 5. Loss of income 6. Damage to road infrastructure 7. Other(s)- Specify

11	Which of the following soil moisture conservation management have adopted as a result of the project support? 1. Use of grass strips 2. Soil bunds 3. Terracing and contour farming 4. Use of cover crops 5. Small scale irrigation agriculture 6. Rain water harvesting 7. Mulching 8. Other(s)- Specify
12	Which of the following soil fertility management technologies have you adopted as a result of the project support? 1. Manure compositing 2. Use of backyard manure 3. Use of inorganic fertilizer 4. Use of green manure 5. Other(s)- Specify
13	Which on farm diversification technology have you adopted to cope with climate related shocks with support from the project? 1. Intercropping 2. Kitchen gardening 3. Practising mixed farming/ integration of livestock and crops 4. Agroforestry 5. Use of new crop varieties e.g. Cassava, sorghum 6. Other(s)- Specify
14	As a community member are you aware of relevant disaster risk reduction and climate change adaptation policies? 1. Yes 2. No
15	Score the state of preparedness of the community for the drought, crop pests, livestock diseases, floods and conflicts on a scale of 1 to 10: 1 being completely unprepared and 10 being completely prepared.

	Climate shock	**State of preparedness Rating**									
		1	2	3	4	5	6	7	8	9	10
	Drought										
	Crop pests										
	Livestock Diseases										
	Conflict										
	Floods										
16	What are the challenges hindering households from adapting to climate change shocks? 1. Lack of information 2. Poor development infrastructure 3. Lack of financial resources 4. Institutional barriers 5. Technology barriers										

Appendix 2: Focused Group Discussion Checklist

How have the rainfall and temperature patterns changed over time in your community?

How would you describe the frequency and intensity of drought in the community in the recent past?

How would you describe the rainfall distribution in your community in the recent past?

Explain the impact of the experienced change in weather patterns on your livelihoods?

Describe how prolonged drought events relate to crop pests and livestock diseases?

Explain how the occurrence of drought influences the incidences of reported conflicts in the community?

How does flood affect the community?

Enumerate the adaptation interventions/technologies you have in your farms as a result of the support received from resilience strengthening project

How have these interventions/technologies contributed to strengthening your resilience to climate change shocks?

What are the challenges you face in embracing adaptation technologies?

Appendix 3: Key Informants Interviews Checklist

What is the major weather shifts witnessed in this community in the past few decades?

What is the major source of livelihoods for most of the community members?

Which are the major climate change risks this community face?

How do extreme weather events of drought and flooding affect livelihoods of the people in the community?

What is the relationship between drought and conflict incidences reported in the community?

How does drought influence incidences and occurrence of livestock diseases?

How do extreme weather events like drought influence incidences and occurrence of crop pests?

What are some of the climate change adaptation technologies supported by the resilience strengthening project?

What challenges do households face in adopting climate change technologies?

Describe how the challenges described above can be addressed