A PROPOSED CLIMATE CHANGE EDUCATION PROGRAMME FOR SINAZONGWE DISTRICT OF SOUTHERN ZAMBIA

By

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DECLARATION

I, **Simpilo Syabwanta**, declare that this thesis represents my own work. It has not previously been submitted for a degree or any award at the University of Zambia or any other institution around the world. All work or materials used in this thesis have been specifically acknowledged and references thereby given.

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ABSTRACT

Effects of climate variability on pastoral farming are a reality in the 21st Century. This has negatively contributed by reducing the practice of pastoral farming in Zambia. The study has proposed a Climate Change Education Programme (CCEP) to address effects of Climate Variability (CV) on Pastoral Farming in Sinazongwe District of Southern Zambia. The study was guided by the following objectives: to investigate perceptions of pastoral farmers toward effects of climate variability on pastoral farming for the period of fifteen years (2001- 2016); to examine effects of climate variability on pastoral farming; to determine existing coping strategies on climate variability among pastoral farmers; to propose a Climate Change Education Programme (CCEP) to improve pastoral farmer's adaptive capacity to effects of climate variability.

The study used qualitative approaches which was guided by a single case study. It employed heterogeneous purposive sampling, purposive sampling, convenient purposive and expert purposive sampling and simple random sampling to select the 70 respondents that included 45 households' pastoral farmers, 10 Agricultural Officers and Veterinary officers, 15 local leaders such as headmen, councillors and community leaders in Sinazongwe District who were divided according to local zones or blocks. Both primary and secondary data collection tools were used.

The results show that pastoral farmers were aware and had knowledge about effects of climate variability on pastoral farming. Pastoral farmers also observed and experienced climate variability through increase in drought prevalence, reduction on the number of livestock, changing rainfall pattern or precipitation, temperature variability, increase in diseases, pest and loss of pasture and occurrence of floods. In view of such effects of climate variability on pastoral farming, pastoral farmers employed diverse coping strategies to cope and adapt to the local problem. These included dam construction, sinking of boreholes, sinking of wells especially in the dry or drought season, pasture management, animal restocking and selling of animals. In addition, pastoral farmers utilised strategies such as livestock breeding change, use of traditional knowledge, herd management, ranching, veterinary services and economic diversification such as fishing and crop farming.

Educational strategies are appropriate to address the effects of climate variability which can increase pastoral farmer's coping and adaptive capacity. The study indicated that pastoral farmers were aware of pastoral farming changes as a result of vulnerability to effects of climate variability. In this regard, it has contributed to the increase in the loss of livestock through poor coping and adaptation strategies being employed by local people because of lack of educational programmes. Climate Change Education Programme (CCEP) is needed to provide appropriate and suitable knowledge and innovative skills among pastoral farmers to enhance their adaptive capacity.

The main recommendation of the study is the need to implement the proposed Climate Change Education Programme to address the effects of climate variability on pastoral farming in Sinazongwe District thereby reducing the loss of livestock. The proposed programme will enhance knowledge to improve pastoral farming. Educational strategies play a key role in addressing societal problems.

Key words: Climate Variability, Coping Strategies, Adaptive Capacity, Pastoral Farming and Climate Change Education Programme.

DEDICATION

To the lovers of new knowledge and wisdom.

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DEFINITION OF TERMS

Climate: As an average pattern of weather for a particular place over several decades

Climate Change: Human induced changes taking place in the world's climate, especially trends towards global warming, which will deeply impact upon the ecosystem.

Climate Variability: Defined as long term average and variations in weather measured over a period of several decades.

Education: Act or process of imparting or acquiring general knowledge, developing the powers of reasoning and judgment, and generally of preparing oneself or others intellectually for mature life.

Pastoral Farming: The type of farming that is related to livestock rather than growing crops and other fodder such as daily farming.

Perceptions: The way in which something is regarded, understood, or interpreted. It can also be defined as the ability to see, hear, or become aware of something through the senses.

Programme: **S**et of plans to develop or improve something or plans of things that are done in order to achieve a specific results.

Proposing To put forward (present, a plan or suggestion) for consideration or action.

Strategies: High level plan to achieve one or more goals under conditions of uncertainty or a careful plan or method for achieving a particular goal usually over a short or a long period of time.

ACRONYMS

AER	Agro Ecological Region
BQ	Black Quarter
CBO	Community Based Organisations
CCE	Climate Change Education
CCEP	Climate Change Education Program
CSO	Central Statistical Office
CV	Climate Variability
DMMU	Disaster Management and Mitigation Unit
ECF	East-Coast Fever
ECZ	Environmental Council of Zambia
EE	Environmental Education
FAO	Food Agency Organisation
FGD	Focus Group Discussion
FISP	Farmer Input Support Program
GDP	Gross Domestic Product
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
LDC	Less Developed Countries
MAL	Ministry of Agriculture and Livestock
MDGs	Millennium Development Goals
MOH	Ministry of Health
MTENR	Ministry of Tourism, Environment and Natural Resources
NAPA	National Adaptation Programme on Action
NCCRS	National Climate Change Response Strategy
NFE	Non Formal Education
NGOs	Non-Governmental Organisation
NPE	National Policy on Environment
PFs	Pastoral Farmers
SDGs	Sustainable Development Goals
SL	Situated Learning
SSI	Semi structured Interviews
UNDP	United Nations Development Plan

UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNZA	University of Zambia
USA	United State of America
WHO	World Health Organization
WMO	World Meteorological Organization
ZCCRS	Zambia Climate Change Response Strategy
ZEMA	Zambia Environmental Management Agency
ZVAC	Zambia Vulnerability Assessment Committee

CHAPTER ONE

INTRODUCTION

1.1 Background

There is debate around the world on Climate Change and Variability. The veracity or validity situation in the last two decade indicate that, many countries around the globe are discussing, formulating, alignment of policies and holding of global, continental, region and local meetings or summits toward finding key or tangible solutions to address the effects of climate variability on all economic sectors in their respective countries and regions (UNESCO, 2010). First and foremost, the effects of climate variability on pastoral farming has been perceived and experienced world-wide. Basically, prior studies and reports conducted outlined that every part of the world is facing an almost overwhelming array of environmental global challenges such as ecological degradation, pollutions, health problem, deforestation, poverty and climate change and variability (IPCC, 2007). These challenges has contributed to unsustainable or poor practice of pastoral farming affecting the well-being of the people especially in developing countries. There had been little or no serious adaptation strategies and programmes at global, continental, regional and country level among pastoral farmers with a clear purpose to address effects of climate variability. The thesis statement is to propose a Climate Change Educational Programme (CCEP) which could be a cornerstone, significant and appropriate to address effects of climate variability on pastoral farming in Sinazongwe District.

1.1.1 Climate Variability

Climate Variability refers to variations in the mean state and other statistics of the climate on all temporal and spatial scales, beyond individual weather events (Thornton, 2007). In essence, climate variability looks at changes that occur within smaller timeframes, such as a month, a season or a year, and climate change considers changes that occur over a longer period of time, typically over decades or longer (IPCC, 2001). According to Environmental Council of Zambia (2001), Zambia has experienced some of its worst droughts and floods in the last two decades were the loss of livestock has increased as a result of negative effects such poor pasture growth, increase in pest and diseases outbreak, temperature variability and availability of water. Thus, the rain-season of 1991 and 1992, Southern Province and other parts of the country experienced severe drought that increased the vulnerability of pastoral farming.

According to International Panel for Climate Convention (IPCC) (2001), observed increasing temperature and declining rainfalls are expected in the future weather patterns of climate change hot spots in the Sub-Saharan Africa since it's located in the Great East Rift Valley which is prone to environmental challenges. In this view, Sinazongwe District has experienced high temperature in the last fifteen years by moving or recording from normal 35°C - 38°C to 40°C 42°C in the hot season. Notably, temperature increase or variability in Sinazongwe District has contributed to poor development of pastoral farming in the past years. This had led to the emerging of new animal health diseases that has increasing the loss of livestock than previously or before. According to Zambia Meteorological Department (ZMD) (2012) reported that most part of the country experienced reduction of temperature and humidity from 2000 to 2014.

The rainy-season of 2006 and 2007, Zambia experienced severe floods which was repeated in the year 2009 and 2010 season leaving more than 2,000 households affected (NAPA, 2007). The evident effects of droughts and floods led to a significant decrease in the productivity of primary sectors like agriculture, fisheries, wildlife, livestock and tourism (MTENR, 2007). In addition, severe flush floods had has been observed or experienced in most parts of the country such as in 2006, 2007, 2009, 2010, 2013 and 2014 inclusively Sinazongwe District of Southern Province. Furthermore, as reported by Thornton, (2008) and IPCC, (2007) rainfall patterns are a serious climatic variability affected the growth of pastoral farming in the Sub Sahara Africa through scarcity of water availability.

Zambia is divided into three major agro-ecological regions (Regions I, II and III), which are primarily based on annual rainfall amount that also incorporate soils and other climatic characteristics. It's located in the Agro-Ecological Region I (AER) covering the Western and Southern part of Zambia. The District lies in the Zambezi escarpment with harsh climatic conditions, where it receives less than 800 mm of rain annually. According to Jain (2006) reported an increase in related animal health diseases, rainfall changes, increase in drought occurrence, on-set rainfall, temperature and other factors affected the agriculture sector in the Region I. The evidence observed and experienced by local pastoral farmers' show that climatic variability has negatively affected the growth of pastoral farming (Mubaya, 2015).

Jain (2006) also reported that Sinazongwe District in Southern Province of Zambia is one of the area facing frequent effects of climate variability on pastoral farming. The study indicated

that if climate actions or measures are not put in place to address the problem, loss of livestock would continue to increase than in the previous decade. Currently, rainfall variability is increasing, the occurrence of droughts and floods, temperature variability and increase of livestock health related problems. Previously, the area was once considered the bread basket of the nation for pastoral farming for many years than today.

1.1.2 Effects of Climate Variability on Pastoral Farming

Agriculture sector is one of the main key of the Zambian economy sector contributing to national development and job creation among the local people (Civil Society Organisation, 2010). This includes pastoral farming, crop farming and aqua agriculture. The emphasis of the study is based on addressing the effects of climate variability on pastoral farming thereby increasing the loss of livestock and lowering animal production in Sinazongwe District. According to the Intergovernmental Panel for Climate Change (IPPC) (2007), there had been an increase in global average temperature above the range of 1.5°C-2.5°C resulting in significant alterations of the structure, functions and geographical ranges of ecosystems and thus negatively influencing species distribution and survival around the world.

Specifically, in developing countries, the majority of the population greatly depends on natural-resource-based livelihoods. This has caused serious effects on the socio-economic status of communities, hampered progress towards development goals and presents an overall threat to sustainable development (IPCC, 2007). Therefore, the effects of climate variability to pastoral farming in Zambia, to be specific in Sinazongwe District has been so rampant in the last three decades contributing to the loss of livestock than previous years as a result of a continuous changing climatic season.

The observed effects of climate variability on pastoral farming in Sinazongwe district consists of increased poor quality pasture, increase in diseases and pest, heat stress, over grazing and scarcity of water for livestock. The Zambia Climate Change Vulnerability Mapping (2010) indicated Sinazongwe District as one of the mapped areas in Zambia, severely experiencing harsh conditions of climate variability affecting pastoral farming and other economic sectors such as fishing and crop farming. According to Sichingabula (1998) also conducted a study in some selected District of Southern Province in relation to rainfall vulnerability. The study

revealed that rainfall variability poses a serious challenge leading to reduction in the practice of pastoral farming which contribute positively in improving the livelihood of the people.

1.1.3 Climate Change Education Programme

Climate Change Education Programme (CCEP) is an educational strategy that intend to provide practical skills, knowledge, understanding and innovative ideas to diverse or different stakeholders which include pastoral farmers, learners, researchers, government, communities and organisations in order to increase their understanding and adaptive capacity to effects of climate variability around the world (IPCC, 2007). The central emphasis is to integrate or mainstream CCEP in all governmental sectors specifically in the Ministry of Agriculture, Ministry of Livestock, Ministry of Environment and Natural Resources and Ministry of National Planning to facilitate and hasten the achieving of Sustainable Development Goals by 2030 in Zambia. The target group should have the capacity to cope and adapt to effects of climate variability by adopting appropriate coping, adaptation and mitigation strategies throughout the year.

The programme requires a cross-disciplinary approach, blending education with active learning, social facet, behavioural, economic sciences and earth systems science (UNESCO, 2007). This can led to increase in knowledge, awareness to the problem and solutions required to improve pastoral farming in Sinazongwe District. The national agencies, Non-Governmental Organizations (NGOs), and businesses need to invest in the programme to enhance all round efforts in coordination, cooperation, and alignment of an overall education strategy through the existing Zambian education curriculum. Climate variability has become a serious national problem affecting all areas of development in the 21st Century (IPCC, 2007).

In view of the above, one of the recommendations of the International Ahmadabad Conference on Environmental Education held in India (2007) tasked countries to facilitates, develop and put emphasis or priority on promoting educational activities from the local to global by cooperating with and supporting the efforts of Non-Formal Educators (NFEs) and Community-Based Organizations (CBOs) in addressing problems that includes social-economic and environmental challenges. Climate Change Education Programme is an essential programme or tool that should be utilised and infused or integrated to bring about sustainability, development, innovation, critical and reflective analysis, participation, change of mind-set and contribute positively in addressing the current existing problem in our communities. However,

little had been done to address effects of climate variability on pastoral farming. It's now crucial and suitable in proposing an educational (learning) programme for pastoral farmers to address effects of climate variability in Sinazongwe District of Southern Zambia.

In view of the effects of climate variability on pastoral farming in Sinazongwe District, pastoral farmers employed strategies to cope and adapt to the existing challenge. It's known that, most of the pastoral farmers did not recognise the effects of climate variability as a direct or indirect driver to the problem as a result of lack of awareness and knowledge. In this regard, the programme could provide in-depth knowledge and promote active participation to enhance their adaptive capacity through education. Therefore, the study seeks to examine the perceptions on the effects of climate variability on pastoral farming, effects of climate variability and coping strategies being used and propose a CCEP for pastoral farmers to address the problem. NAPA (2010) stresses or emphasise the need for specific programmes, plans, strategies and adaptation actions to mitigate and address the problem. This should involve various stakeholders from the local to national level.

1.2 Statement of the Problem

Although Climate Change Education (CCE) is one of the newly developed strategies that could be used to address diverse effects of climate change and variability as stated by the National Climate Change Response strategy (MTENR, 2012) it still remains one of the least explored approaches or strategy to address Climate Variability (CV) in Zambia. The loss of livestock among pastoral farmers in the last two decades had been as a result of climatic variability. This has contributed to the decline of local people practicing pastoral farming as a results of the increasing climate variability. Therefore, little has been done to address the challenges being faced in the pastoral farmers in Zambia, particular in Sinazongwe District.

Henceforth, without clear understanding of how Climate Change Education (CCE) could be a relevant tool to address Climate Variability, people and pastoral farmers in particularly can continue to engaging in climate-unfriendly practices that could heighten already changing climate. There can also be no behavioural and social change among pastoral farmers to promote sustainable adaptations to effects of Climate Change and Community Adaptation Capacity. In view of the above, without addressing the effects of climate variability on pastoral farming, the loss of livestock would increase thereby endangering or threatening the livelihood of the local

people and enhancing of positive contribution to national development. Hence, the study intend to contribute to the existing knowledge gap by proposing an educational programme (CCEP) to address the effects of climate variability on pastoral farming through a deliberate community learning programmes to enhance adaptive capacity among pastoral farmers in Sinazongwe District.

1.3 Purpose of the Research

The purpose of the study is to propose a Climate Change Education Programme to address effects of Climate Variability on Pastoral Farming.

1.4 Specific Objectives

The objectives of the research include the following:

1. To investigate the Perceptions of Climate Variability among Pastoral Farmers from 2001 to 2016 in Sinazongwe District?
2. To examine the effects of Climate Variability on pastoral farming in Sinazongwe District.
3. To determine the Coping Strategies to Climate Variability among Pastoral Farmers in Sinazongwe District.
4. To propose a Climate Change Education Programme to address the effects of Climate Variability on pastoral farming in Sinazongwe District.

1.5 General Research Question

How can Climate Change Education Programme be used to address the effects of Climate Variability on Pastoral Farming in Sinazongwe District?

1.6 Specific Research Questions

1. What are Perceptions on the effects of Climate Variability on Pastoral Farming from 2001- 2016 in Sinazongwe District?
2. What are the effects of Climate Variability being faced in Sinazongwe District?
3. What are the Coping Strategies that are taking place in Sinazongwe District?
4. How can Climate Change Education Programme address the effects of Climate Variability among Pastoral Farmers in Sinazongwe District?

1.7 Significance of the Study

In line with the Zambia Climate Change Response Strategy (ZCCRS) of 2010, the results of the study could also be valuable to decision makers on climate change and variability and, also to EE practitioners because CCE is one of the current issues in the practical context of the latter. Climate Action is one of the newly Sustainable Development Goals (SDGs) number thirteen (13) which is now a Global Goal building success from the Millennium Development Goals (MDGs) with set targets to be attained by 2030 to improve life in a sustainable way for present and future generation by tackling pressing challenges facing our world today. Hence, this study would support the 2030 Agenda which is the top priority by United Nation Development Plan (UNDP) by developing an educational programme which is one of the urgent action required to combat or address effects of climate variability on pastoral farming.

CCEP could bring about new knowledge, participation, understanding, good values, skills, social and behaviour change. The adaptive capacity among pastoral farmers would be enhanced by address the effects of climate variability through active community learning and sustainable practices. The study could add valuable contribution to the already existing body of knowledge in the area of climate variability in Zambia and other countries around the world facing similar situations. The study would help the following institution such as the University of Zambia (UNZA), Zambia Environmental Management Agency (ZEMA), Ministry of Education (MOE), Ministry of Agriculture and Livestock (MAL), Ministry of Environment, Land and Natural Resource to put-up in place an appropriate, relevant, practical and short and long terms strategies in the local perspective.

1.8 Environmental Education (EE) Context of the Study

According to the 4th conference on Environmental Education (EE) held in Ahmadabad in 2007, climate change was deemed to be one of the most important issues facing humanity in the 21st Century and beyond. According to UNESCO (2007) climate change and variability are complex issue that must never be viewed from a linear perspective but in a broader picture because of being interlinked in nature. This means that, there are holistic and crosscutting issues broadening from socio-ecological, political and economic facets (Muchanga, 2011). In relation to the above, Article number five (5) of the Ahmadabad Framework provide guidelines and process on what must constitute Environmental Education (EE) Practice in the 21st Century with focal attention on addressing global climate change and variability. In reality, it

is now one of the major priority issues or concerns toping the international political agenda today world-wide. Therefore, it should be one of the critical issues that require emphasis in Environmental Education (EE) (UNESCO, 2007). In particular, today, Climate Change Education (CCE) is receiving attention to EE practitioners, NGOs and researcher. It's thematic area or themes requires recurrent studies within broader frames of EE to address societal problems that has become a threat to humanity. In this regard, proposing a CCEP for pastoral farmers could provide the alternative and tangible solution in addressing the current challenges being faced through participation, practice and learning.

1.9 Conceptual Framework

The meaning of the conceptual framework was to provide a clear picture and depicted ideas of the study as indicated in (Figure 1.1). First and foremost, the study focused on proposing a CCEP for pastoral farmers in Sinazongwe District as an intervention or strategy to address the effects of climate variability. It was reported and observed that, pastoral farming has had declining or abating as a results of drastic loss of livestock in the last two decades. This was due to the fact that farmers had lack or little appropriate knowledge, awareness and understanding on how to cope and increase their adaptive capacity to the effects of Climate Variability (CV). Therefore, without CCEP in Sinazongwe District, pastoral farmer could continue facing the problem now and in future. Henceforth, the study focused on investigating the perceptions of pastoral farmers on the effects of climate variability in Sinazongwe from 2001to 2016, examining the effects of climate variability on pastoral farming, determining the local coping strategies to effects of climate variability being practiced among pastoral farmers and proposed a CCEP for pastoral farmers in Sinazongwe District to address the effects of climate variability.

Climate Change Education Programme (CCEP) as a new educational strategy that can be used to teach, educate and provide information to diverse stakeholders and pastoral farmers on how to cope and adapt to the effects of climate variability. The proposed programme could be a deliberate educational strategy to address challenges being faced by pastoral farmers. This could provide practical skills, knowledge, social and behaviour change, deeper understanding, critical thinking and transformation to improving their well-being despite the adverse and unstable climatic changes and variability (Muchanga, 2013).

The programme can be applicable and essential among small and commercial pastoral farmers. This is meant to enhance active learning process through participation and application of friendly strategies in addressing the effect of climate variability among pastoral farmers. The use of friendly and sustainable practices such as early warning system, restocking, crossbreeding and many more that could be vital to monitor and predict climatic trend currently and in future, reduce loss of livestock and increase their adaptive capacity. Living and coping with effects of climate variability requires involvement of stakeholders, active participation, use of appropriate and sustainable coping and adaptive strategies, implementing of the proposed programme to pastoral farmer and integration or mainstreaming of Climate Change Education Programme in the developmental process. The Figure 1.1 shows the conceptual framework of the study.

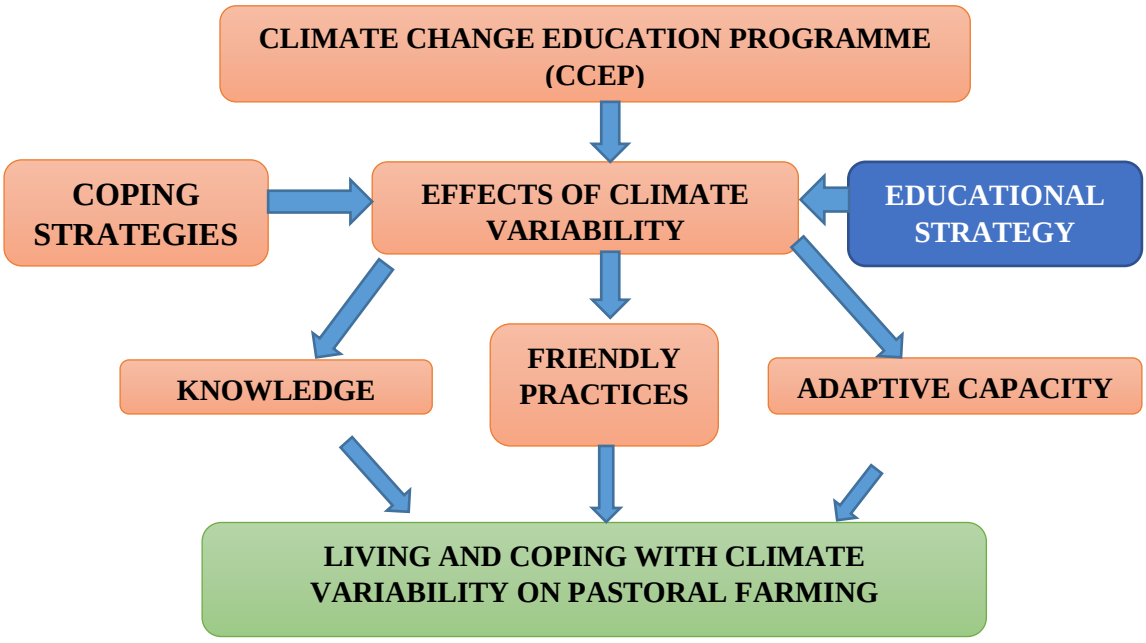

Figure 1.1: Conceptual Framework of the study on effects of Climate Variability on Pastoral Farming in Sinazongwe District.
Source: (Adapted and Modified from Jain 2016).

1.10 Theoretical Framework

The study was guided by a theoretical framework called Situated Learning (SL). This theory is associated with Lage and Wenger (1991) which was proposed as a model of learning in a Community of Practice. The assumption was that "Action or Learning is grounded in the concrete situation it occurs were learning take place depending to the situation on the environment. Hence, the assumption of the theory was applicable to the study that, pastoral

farmers could be involved in the learning process while practicing on how they can cope and adapt by implementing applicable friendly strategies in their everyday livelihood.

The other assumption of the theory stated that "learning is a social process whereby knowledge is co-constructed and it should not be viewed as simply the transmission of abstract" (Ghaffar, 2005). Situated learning essentially was a matter of creating meaning from the real activities of daily living (Stein, 1998). This theory suggested that learning takes place through the relationships between people and connecting prior knowledge with realistic, informal, and often unintended contextual learning. It also explains that learning was a result of social process encompassing ways of thinking, perceiving, and problem solving and interacting to declarative and procedural knowledge. Learning is not separated from the world of action but exists in robust, complex and social environments made up of actors, actions, and situations" (Cresswell, 2003). The proposed Climate Change Educational Programme (CCEP) for Sinazongwe District may promote the growth of pastoral farming through active participation, sound decision making engage in the learning process and collaboration with other stakeholders to reduce the loss of livestock.

The theory was applicable to the study purposively intended to engage the learners (pastoral farmers) in complex, realistic, problem centred activities meant to support the desired knowledge (Cohen, 2011). Pastoral farmers were engaged in authentic learning situations that could actively immerse in an activity while using problem solving (critical thinking) skills such as applying of friendly practices to cope and adapt to the existing problem. The study increased respondent's opportunities of being involved in social community which simulated the real world situations on how to address the effects of climate variability. Similarly, according to Stein (1998) the situated learning experience encouraged students (learners) to tap their prior knowledge and to challenge others in their community. Moreover, Climate Change Education Programme (CCEP) can be used to hasten the learning process by enhancing the adaptive capacity through acquiring of knowledge, skills, awareness and change of behaviour and social aspect to live in a better community.

1.11 Organisation of the Dissertation

This thesis was organised into seven chapters. The first chapter comprises of the introduction, statement of the problem, purpose of the study, objectives of the study, general research question, research questions, significant of the research study, operational definition of concept, and Environmental Education context of the study, conceptual and theoretical framework of the study. Chapter two consists of the literature reviews in theme using the objective. Chapter three involve the description of the study area and chapter four contains of the methodological framework of the study. The fifth chapter of the study is the presentation of findings. The sixth chapter involve the discussion of findings and lastly the seventh chapter comprises of the conclusion and recommendations generated from the study.

1.12 Chapter Summary

This chapter covered the introduction, explained the statement of the problem, purpose of the study, study objectives and research questions that were used. Additionally, the significance of the study, key concepts linked to the study, Environmental Education (EE) context of the study, conceptual and theoretical framework, pilot study, organisation of the dissertation and ended with a chapter summary.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Having shown the introduction chapter in the previous section, this chapter presented the relevant literatures from the global to local perspective. This chapter explained the understanding of climate variability and climate change, the perceptions of pastoral farmers on effect of climate variability on pastoral farmers, the effects of climate variability on pastoral farming, coping strategies to climate variability and educational programmes or strategies used to improve pastoral farmer's adaptive capacity to effects of climate variability.

2.2 Perceptions of Pastoral Farmers on the Effects of Climate Variability:

In this section, the perceptions of farmers on the effects of climate variability on pastoral farming was explained from the global to the Zambian context or perspective. Perceptions is simply refers to a diverse views from respondents or people on the subject under discussion. In this regard, in this study it was appropriate to understand pastoral farmer's knowledge, ideas and experiences.

2.2.1 Global perspective

Perceptions among pastoral farmers around the world toward climate variability were notable such as changes in rainfall cycles, droughts in some areas and flooding in others which are impacting agricultural yields in Latin America, Asia, and Africa (Clements *et al.*, 2011). These changes were perceived by affected populations around the globe. Studies focused on farmers' perception of climate change and variability in Latin America are limited, but some descriptive work has been done. A study by Browning-Aiken *et al.*, (2007) indicated that most rural respondents in Mexico had experienced lower water supply due to drought in the past ten years.

According to Sanchez (2011) the study reviewed that Mexican peasant farmers had experienced decreasing rainfall and increasing temperature contributing to modification or change in corn planting dates and shifting of crops in warmer regions. Similar studies also reviewed that most of the members of agricultural communities in Cotacachi (Ecuador) also perceived that temperatures are rising affecting crops and animals adversely (Vander Molen, 2011). In Chile, Gonza ´lez and Velasco (2008) also studies on the impacts of climate change

on agricultural profits reported that, in recent decades, 97 % of farmers surveyed had perceived prolonged droughts, higher average temperatures, and alterations in the growing season. The results showed that most farmers in the survey recognised that there were changes in temperature and precipitation patterns during the last 24 years in the country.

2.2.2 African Perspective

According to Maddison (2006) argues that perception of pastoral farmers in Africa on effects of climate variability was observed and climatic conditions changed from the way it was in the past than it's today. The study revealed that most of the pastoral farmers had experienced increase in temperature and decline in precipitation in Southern and East Africa. Similar studies were conducted on examining farmer's adaptation strategies in South Africa, Zambia and Zimbabwe were farmers had observed long-term change in temperature and precipitation or rainfall in the Southern African region. The study by Nhemachena and Hassan (2007) in Northern and East Africa reported that farmers perceived long-term increase in temperature and the region was getting drier were changes in the timing of rains and frequency of droughts had been observed. According to Fosu-Mensah *et al.*, (2010) in Ghana, similarly pastoral farmers also perceived long term changes in temperature, rainfall and vegetation cover over the past two years.

According to Mandleni *et al.*, (2011) also reported farmer's perceptions on climate change and variability in the Eastern Cape of South Africa. The study reviewed that about 86% of the local farmers were aware of the increase in temperature and changing or variations in weather conditions in the province but were dominated by drought occurrence. The analytical results show that about 83% of the respondents reported that harsh weather conditions has led to the reduction or decline in animal population or number of cattle or livestock. Further, similar study by Mertz *et al.*, (2009) analysed farmers' perceptions of climate change and adaptations in the Savanna Zone of Senegal. The results of the study also showed that farmers in this Zone are aware of climate variability and identified intensive wind and occasional excess rainfall as the most destructive climatic factors.

In Osun State of Nigeria, Baruwa *et al.,* (2011) surveyed 100 farmers to gather information on their perceptions about changes in temperature and precipitation. The study used the Multinomial Logit Model to analyse the factors that determine farmer's adoption of various

climate change adaptation measures. The results show that more than 75% of the respondents were aware of increase in temperature and precipitation in the region. Acquah de Graft (2011) also assessed farmers' perceptions and adaptation to climate change and variability as well as the socioeconomic determinants of willingness to pay for climate mitigation policies in Ghana through the use of descriptive statistics and the Logit Model. The study results indicated that 60% reported that there was evident increase in temperature and 49% reported a decrease in rainfall in the area.

A study conducted by Mertz *et al.,* (2009) showed that farmers in Savanna Zone of Senegal were aware of climate change and variability, and identified intensive wind and occasional excess rainfall as the most destructive climatic factors. The study also figured out that households in the area noticed a decreasing trend in overall rainfall and increased temperatures throughout the year and that cold periods have become shorter and hot periods longer. Apata *et al.,* (2009) also analysed arable food crop farmers' perceptions about climate change and adaptation strategies in South-Western Nigeria and the results of the study indicated that about 89% of the farmers perceived a significant increase in temperature, 72% perceived higher evapo-transpiration rates, 68% indicated that there has been violent rain and hailstorms and 65% experienced delayed rainfall and early cessation.

2.2.3 Zambian Perspective

In the Zambia context, Nyanga, and Kahinda (2011) also interviewed 469 farmers from 12 districts in Zambia to elicit information on their perceptions of climate change and climate variability impacts in the country. Most farmers reported on having perceived an increase in the duration of the cold season, no change in the duration of the hot season and a reduction or decline in the rainy season's duration or spell. Local pastoral farmers in Southern Province perceived an increase in the frequency of droughts and floods which has affected the growth of pastoral farming through pasture, infrastructure destruction and has increased some animal disease in the area such as tick and foot mouth diseases, corridor and anthrax.

Similarly, DMMU (2007) (in GRZ, 2007) reported that 2007 flush floods affected 41 out of 72 Districts in Zambia that included areas which were never affected before such as Sinazongwe District. Historical data proved that recent floods were more widespread and frequent. Thus, in some years rains were experienced so early despite being expected so late in the area. These

effects are indicators of the changing pattern of climate in Zambia in which the rainy season has changed. It's clearly reported that, Zambia experienced two major floods (2002/3 and 2006/7) were the agriculture sector was affected. The country further experienced massive flooding in the years 2008/9 and 2009/10 (GRZ, 2007). In addition, floods are more destructive if they occur in dry areas as compared to wet areas. This is so because dry areas have reduced vegetative cover and floods tend to sweep the top fertile soil layers together with the little vegetative cover available causing severe soil degradation.

2.3 Effects of Climate Variability on Pastoral Farming:

This section involves the effects of climate variability on pastoral farming from global to the local or Zambian perspective. This involves challenges pastoral farmers experienced that has had led to increase in the loss of livestock. This challenges includes the following such as increase and reduction in temperature, rainfall variability, delayed on the onset rainfall, water shortage, heat stress, drought occurrence and outbreak of diseases and pest.

2.3.1 Global perspective

According to IPCC (2007) USA had experienced increase in heat stress and water demand among pastoral or livestock systems. In the years 1992, 1995, 1997, 1999, 2005, and 2006, that some feedlots for intensive cattle feeding operations lost in excess of 100 head each during severe heat episodes. The heat waves of 1995 and 1999 were particularly severe with documented cattle losses in individual states approaching 5,000 head each year (Notenbaert *et al*., 2010). Similar studies conducted by IPCC (2004) indicates that the intensity duration of the 2005 and 2006 heat waves were just as severe as the 1995 and 1999. The heat waves affected the agriculture sector in the USA. According to Mader *et al.,* (2009) the study which was based on the confined swine, beef and milk producing cattle on climate change and variability projections in daily ambient temperature. Results of analysis reviewed economic losses for livestock production which could increase in most cases especially during the summer period.

A similar study by Nardone *et al.,* (2010) on the effect of climate change and variability on animal production and sustainability of livestock systems discovered that a relevant increase in drought could be expected across the world which will affect forage and crop production. The heat was predicted to impair productivity such as milk yield and quality, meat quality and egg yield, metabolic and health status of livestock. Further, desertification as reported was

expected to decrease carrying capacity of rangelands resulting in poor nutrition of livestock, poor animal health and mortality of calves. It can be noticed that, effects of climate change and variability on livestock in USA are also there due to lack of knowledge among pastoral farmers and local people.

According to Bangladesh's National Adaptation Programme of Action (NAPA), and numerous other scientific-based assessments, the primary anticipated impacts of projected climate change, including variability, inundation of coastal lands. The key risks include drainage congestion, reduced freshwater availability, disturbance of morphologic processes, and increased intensity of flooding. These risks are classified as arising from gradual long-term Climate Change, changes in the frequency and intensity of extreme events (climate variability), or both. In this regard, according to literature reviewed Climate Change has also negatively impacted the pastoral farmers in Bangladesh in which there has been lack of water in the country, increase in temperature and other natural disasters such as floods and droughts. It can be noted, similar challenges of climate change and variability around the globe with few differences affecting pastoral farming (NAPA, 2008).

According to Jones *et al.,* (2000) effects of climate change and variability on pastoral farming in Australia has been seen and experienced by pastoral farmers. Similarly, increase of heat stress among cattle is common as a result reducing the grazing time, feed intake of livestock, increased body temperature, change in respiration rate, and weight loss. Furthermore, in daily cow, heat stress has caused reduction in milk yields, fats and proteins and decreases reproduction rate of livestock in the country. Hall (1998) argues that severe changes in both pasture production and forage quality is as a result of effects of climate change and variability. In addition, like in USA and Europe, there has been severe impact of climate change on vegetation composition, increase in pest, diseases, weed, soil erosion, animal husbandry and, health and changes in the amount of rainfall (Crimp *et al.,* 2002).

2.3.2 Africa Perspective

Africa is seen as the most affected continent on the effects of climate change and variability on agriculture that includes pastoral and crop farming. According to Thornton *et al.,* (2002) indicated that out of the planet's 1.3 billion poor people, at least 90 percent of them are located in Asia and sub-Saharan Africa. About 60 percent of these poor people depend on livestock for

some part of their livelihoods. Climate change and variability has caused major effects on poor livestock keepers and on the ecosystem goods and services which they depend on. These effects include changes in the productivity of forage, reduced water availability, more widespread water shortages, and changing severity and distribution of important human, livestock and crop diseases. In this regard, major changes were noticed in the livestock systems, livestock species and feed resources in Africa as a result of continuous climatic change and variability.

According to IPCC (1990) first report on Climate Change assessed temperature projections have suggested global average temperature is increased between 0.15 and 0.3°C per decade. This increase has been observed around the globe in including Africa were pastoral farming sector has also been affected. Greenhouse gas emission could be raising globally 25–90% by 2030 and temperatures could be increased by 3% by the year 2050 (IPCC, 2007). It is further predicted that even with a small temperature rise of 1-2.5%, the consequences could still be severe, exerting far-reaching impacts on the livelihood of many people. Therefore, Africa is already a continent under pressure from climate stresses and is highly vulnerable to the effects of climate variability and change.

Similar, NCCRS (2010) argues that Kenya has also experienced the brunt of climate change and variability manifested in the form of change in frequent, intense and long lasting droughts, temperature and rainfall patterns. For instance the country had experienced three major and more pronounced droughts in the 1990s affecting the pastoral farming. The drought of 1991/92 had much destruction such as 70% loss in livestock herds were noticed and experienced and high rates of malnutrition of up to 50%. This contributed about 1.5 million people that included pastoral farmers in the ASALs to dependent on relief food for survival. The 2006 to 2009 droughts are testament to the devastation that climate change could cause to the livestock sector as most pastoralists lost more than half of their herds to drought due to lack of water, animal diseases and pasture. Similar studies have been conducted in Somalia on the impact of climate change which entails that it has been experienced among the local people through unusual recurrence of droughts, increase in animal diseases, and land degradation decline in crops and livestock production (IPCC, 2010).

According to FAO (2008), the changing condition would increase animals' diseases and newly emerging diseases particularly in Africa which is undergoing an enormous burden of animal

diseases. Thornton *et al.*, (2006) argues that increasing drought conditions in East Africa could reduce water availability and hence increase the rate of infections due to increased interaction between livestock and wildlife. However, the IPCC report argues that, due to the effect of climate change and variability in the 21st century, it's projected that many countries to experience increased ill-health and particularly developing countries characterised with low income as compared to developed countries (IPCC, 2004).

In Ethiopia, Deressa *et al.*, (2008) conducted an integrated quantitative vulnerability assessment for seven Regional States using a biophysical and social vulnerability indices of Ricardian approach. The study reviewed that decline in precipitation and increase in temperature are both damaging to Ethiopian agriculture. The results pointed out that Oromiya Regional State, where West-Arsi is located, was one of the most vulnerable regions to climate change and variability. Changes in climate variability and frequency of extreme events have substantial impacts on the prevalence and distribution of pests, weeds, and crop and livestock diseases affecting pastoral farming production. For example, in the past, combinations of drought followed by high rainfall have led to wide-spread outbreaks of diseases such as Rift Valley fever and bluetongue in East Africa and of African horse sickness in South Africa increase the loss of livestock among pastoral farmers (Githeko, 2006).

In addition to the reviewed case of Kenya and Swaziland was forecasted to be among the countries in the Sub-Sahara countries affected by the effects of climate change and variability. Thompson (2013) reported that the livestock subsector accounts for about 14% of agricultural output and 1% of total GDP in Swaziland. It was relatively high unexploited potential of improving livestock production where 83% of the country's livestock is reared. Additionally, climate variability had affected the natural resources such as reducing the water sources, land and pastures, biodiversity and increases in poor livestock health (UNFCCC, 2014). This had a direct effect on livestock production and livestock systems worsening the livelihood of the people such as increasing their burden to poverty, diseases and vulnerable to occurrence of droughts.

According to Nassif (2008) revealed that livestock production in Morocco was an integral component of agriculture contributing to the economic development. Moreover, based on the agricultural census of 1996, livestock keeping was practiced by 1 100 123 farm-households which represented three fourths of the approximately one million and half (1 496 349) farm-

households in Morocco. In addition, the study revealed that pastoral and agro-pastoral systems of the country, livestock was central to livelihoods of rural communities because it was widely practiced. Most importantly, livestock production was carried out in arid and semi-arid regions of the country due to the high degree of exposure of livestock to climatic variability and erratic nature. Furthermore, argues that in Morocco, variations of animal stock were well correlated to climatic conditions thereby increasing the vulnerability of the livestock as the severe droughts are being experienced among pastoralist.

2.3.3 Zambia Perspective

According to Bwalya (2007) a study on climate change and variability noted significant amounts of household goods, livestock being damaged and lost during the 2007/2008 floods that happened in most part of the country. These area includes most part of Southern, Lusaka, Western, Copperbelt, Central and North-Western Province were adversely affected. The local people faced critical hunger or shortage of food, and there dependence or reliance was on humanitarian assistance and wild-food for their livelihood and survival. In view of this, increase in the loss of livestock was noted due to outbreak of animal diseases and pest, animal stress, lack of pasture and other notable challenges which faced pastoral farmers faced.

The study revealed that livelihoods based on agricultural systems on the flood plains may no longer be sustainable and households need to identify other livelihood systems outside the flood plains for them to survive. Similarly (ZVAC, 2008: NAPA, 2008 and Mulenga, 2014) also reviewed that pastoral farming in the mapped Districts in Zambia was affected and declined as a result of the effects of climate variability on the agriculture sector in the last two decades. The change of practice from pastoral farming to other economic ventures such as crop farming and business are widely noticed as a way of coping and adaptive to their vulnerability were most of the area are now not favourable to pastoral farming due to increasing cost and environmental challenges.

The Disaster Management and Mitigation Unit (DMMU) assessed that during the 2007/2008 floods, over 495,972 households in 39 districts of Zambia were adversely affected and 8 percent of these were displaced. According to the ZVAC (2008) reports showed that the displaced households, 87 percent were in the rural while 13 percent are in urban areas. Hence, it can be noted that the effects of climate change and variability among pastoral farmers has

led to the increase in the loss of livestock as a result of increased occurrence of floods that is destroying pasture, increasing animal health stress and many others challenges. In this regard, many pastoral farmers were forced to move to other places that are not climatic favourable for the animals and prone to animal diseases. It is observed that, lack of information on early warning system to pastoral farmers on how to avoid the effects of climate variability by responsible stakeholders has also contributed to the problem were pastoral farmers are not informed on livestock management in order to cope and adapt to climatic change and variability.

The evident on the effects of droughts and floods had led to a significant decrease in the productivity of primary sectors such as agriculture, fisheries, transport, wildlife and tourism (MTENR, 2007). Significant losses in net agriculture revenues were recorded and associated to increased climate variability such as increase in temperature and reduction of rainfall in most part of the country. Recent studies conducted under the National Adaptation Programme of Action (NAPA) in Zambia indicated that, the regeneration capacity of the Miombo forests and woodlands had slowed down or reduced due to increasing temperatures in Southern, Eastern and Western Province of Zambia. Hydropower production and wildlife based tourism which are natural resource-based and sensitive climate variability were adversely affected. The increase in malaria cases and other climate sensitive diseases shown to be significantly correlated with current climatic trends in Zambia contributing to the loss of livestock (Mulenga, 2017).

IPCC (2007) reported that yield from rain-fed agriculture could be reduced by up to 50% by the year 2020, contributed to the loss of livestock in African. In this regard, agricultural production including access to food which has been compromised in the last two decades due to increasing effects of climate variability. This has further adversely affected food security and exacerbate malnutrition. The projected future climate could worsen effects further with most vulnerable groups being adversely affected socio-economically. In this regard, it can be noticed that effects of climate variability on pastoral farming includes temperature changes or variability, diseases increase, natural disasters, floods, droughts and rainfalls patterns affecting the growth of pasture and water availability would still be experienced.

Jain (2006) assessed the economic impacts of climate change on agriculture in Zambia, based on the Ricardian method which measured the effect of climate on the value of agricultural land.

The Ricardian method was modified by replacing land value with net farm revenue as Zambia had an abundance of free farming land for subsistence farming. A multiple linear regression model with net farm revenue as response variable that can fit with climate, hydrological, soil and socio- economic variables as explanatory variables. The results indicated that most socio-economic variables are not significant whereas some climate variables and the corresponding quadratic variables are significant in the model. The study revealed that mostly in November–December there was an increase in the mean temperature and a decrease in the mean rainfall in January–February that negatively impacted on net farm revenue.

Riché (2007) undertook a climate change vulnerability assessment based on community consultations in seven locations in Zambia and came to the conclusion that Zambia faces increased risks due to a rise in the frequency and severity of extreme events, including droughts, floods and high temperatures, and a decrease in the length of the rainy season. The rise in extreme climatic events is negatively affecting the natural, physical, financial, and human resources that are crucial for people's livelihoods, and is leading to increased food insecurity and health issues. When facing climate hazards, small scale farmers (which are negatively affected by disruption of their normal farming cycles) rely heavily on access to alternative natural resources from forests and wetlands.

2.4 Coping Strategies among Pastoral farmers:

A wide range of possible adaptation or coping options exists from technological changes to increase or maintain productivity among pastoral farmers. Learning, policies and investment in specific sectors may increase the adaptive capacity of poor livestock keepers. Kurukulasuriya and Rosenthal (2003) defined a typology of adaptation a micro-level adaptation options, including farm production adjustments such as diversification and intensification of crop and livestock production, changing land use and irrigation, and altering the timing of operations. Market responses that were potentially effective adaptation measures to climate change, such as insurance and credit schemes, and income diversification opportunities. The third response was institutional and policy changes, such as the removal or putting in place of subsidies, the development of income stabilization options, improvements in agricultural markets, and the promotion of inter-regional trade in agriculture.

2.4.1 Global Perspective

In response to effect of climatic change and variability on pastoral farming among farmers, farm households over the years have had developed different coping strategies in the aftermaths of climate change and variability induced shock on the environment. Prior studies have shown that coping and adaptive capacity of people vary from region to region depending to the vulnerability or prone to the problem. Mostly, there are related to changes in societal aspects such as land use and cultural practices that reveals coping with climatic changes should require a combination of various individual responses at the farm-level and assumes that farmers have access to alternative practices and technologies in their locality to address the problem.

In the Middle East, one of the existing coping strategy farmers had adopted to address crop and animal diseases was through access to agricultural extension services and veterinary services in combination with local knowledge, where finances were limited (IPCC, 2006). Pastoral farmers from both sub-locations sought veterinary services to treat livestock diseases such as East-Coast Fever (ECF). According to Thornton (2008) revealed that most of the pastoral farmers used a hot rod to burn the swollen nodes on the animal before seeking veterinary services. Muhonia farmers considered lack of veterinary services as an impediment to their adapting. The study revealed that farmers used their local knowledge to cope and adapt, as well as appreciated other external sources of knowledge such as veterinary services meant to enhance their adaptive capacities to pastoral farming (Nassif, 2008).

Local coping strategies are an important element of planning for adaptation. Climate change and variability is leading communities to experience climatic extremes more frequently, as well as new climate conditions and extremes. Traditional knowledge can help to provide efficient, appropriate and time-tested ways of advising and enabling adaptation to climate change in communities who are feeling the effects of climate changes due to global warming. Several examples of local coping strategies are mentioned in the background papers to the workshops (UNFCCC 2007).

In Asia, farmers have traditionally observed a number of practices to adapt to climate variability, for example intercropping, mixed cropping, agro-forestry, animal husbandry, and developing new seed varieties to cope with local climate. Various water use and conservation strategies include terracing, surface water and groundwater irrigation; and diversification in

agriculture to deal with drought. Structural and non-structural measures are used to deal with flood and coastal inundation (Kurukulasuriya, 2003).

In Latin America, local coping strategies include a variety of agricultural practices, ecosystem protection and methods to adapt to extreme events. Farmers in Peru have been using an ancient irrigation and drainage system "waru waru", or raised field agriculture, which makes it possible to bring into production the low-lying, flood-prone, poorly drained lands found all over the Altiplano. The shallow canals provide moisture during droughts and drainage during the rainy season. When filled with water they also create a microclimate that acts as a buffer against night time frosts. The waru-waru system provides farmers with greater harvest security and reduces the risks associated with frosts and drought (Nardone, 2003).

In South America among the Aymaran indigenous people of Bolivia have been coping with the effects of droughts through the construction of small dams "qhuthañas". These dams collect and store rainwater from 50 to 10,000 cubic meters. In El Salvador communities employ a number of soil conservation measures to cope with recurrent droughts, for example building barriers consisting of stone and pine suckers, which provide edible fruits and additional income to the local people since there had been an increase in the loss of livestock. The studies provides information on the coping strategies employed such as construction of dam for water storage and conservation that could be used for pastoral farmers to support their animals in dry season due to increasing reduction of water in Bolivia (IPCC, 2010).

Additionally, the short-term adaptation measures for climate change by farmers includes crop insurance for risk coverage, crop/livestock diversification to increase productivity and protection against diseases, adjusting the timing of farm operations to reduce risks of crop damage, change crop intensity and adjust livestock management to new climatic conditions, food reserves and storage as temporary relief, changing cropping mix, permanent migration to diversify income opportunities, defining land use and tenure rights for investments. On a long term note, development of crop and livestock technology adapted to climate change stress, develop market efficiency, irrigation and water storage expansion, efficient water use, promoting international trade, improving forecasting mechanisms, institutional strengthening and decision-making structures are some of the strategies pastoral farmers have used in Europe to address the effects of climate change and variability (Thornton, 2010).

2.4.2 Africa Perspective

Mendelson (2006) used the Multinomial Logit Model to analyse crops and livestock choice as a climate change and variability adaptation option in Burkina Faso, Cameroon, Niger, Senegal, Egypt, Ethiopia, Kenya, South Africa, Zambia and Zimbabwe. The results reviewed that pastoral farmers tend to choose goat and sheep as oppose to beef cattle and chicken. Goat and sheep can do better in dry and harsher condition than beef cattle. McPeak *et al.*, (2005) the study focused on the coping strategies used by pastoralists during recent droughts in Northern Kenya and Southern Ethiopia, and the longer-term adaptations that underlie these strategies. The study argued that animal mobility is the most important adaptive behaviour of pastoral societies in response to spatial-temporal variations in the quality of pastures and water resources and it is widely practiced by the local pastoralist in Kenya and Ethiopia to cope with the effects of climate change and variability. In wet and in dry years pastoralists utilize fall back grazing areas unused in 'normal' years.

Herd accumulation is another coping strategy used by pastoral farmers which is a form of insurance against drought or disease. Today, small proportion of pastoralists now hold some of their wealth in bank accounts, and others use informal savings and credit mechanisms through local shopkeepers. In addition, pastoralists are using supplementary feed for livestock, purchased or lopped from trees, paying for access to water from boreholes and using veterinary services to manage livestock diseases and inter-household transfers are a traditional social insurance arrangement that provides informal transfer of a breeding cow when a pastoralist's household suffers herd losses. However, these transfers or local re-stocking purchase schemes cover only idiosyncratic losses and break down in the event of covariate or aggregate losses typical of extreme events such as severe, drought, floods or disease (IPCC, 2007).

Nyong *et al.*, (2007) carried out a studies in Ethiopia that reviewed the use of indigenous adaptation strategies among Sahelian community in increasing the adaptive to impact of climate change and variability among pastoral farmers. This could be done through the use of emergency fodders in times of drought, multi-species composition of herds to survive climate extremes, culling of weak livestock for food during period of drought, change of cattle to sheep and goat husbandry and pastoralists nomadic mobility which reduces the pressure on low carrying capacity grazing areas through the circular movement from dry Northern area to the

wetter Southern area of Sahel. In this regard, only few pastoral farming are utilising the strategies to cope with the effects of climate variability.

In Tanzania, good pastoral policies and strategies have promoted ranching which was seen as the best way to produce high value goods. In this regard, best adaptation decision making actions where resources are limited and had to address multiple existing stresses such as completion for grazing land and water from other land uses such as cultivation and livestock diseases MacGregor (2009) argues that there was need to integrate all designed policies and plan in order to make local people understand the effects of climate change and variability and reduce the vulnerability.

Kristjanson (2012) argues that despite the pastoral farmers experiencing waste effects of climate change and variability in East Africa. They had been practising coping strategies in their household and community level by improving water, land and livestock management system. The prior studies also explains that pasture management, change of breeds and introduction of new technologies in agriculture for small scale farmers are the most practiced adaptation strategies. In addition, livestock change and management strategies which includes selling livestock to create herds of a manageable size with the focus on fodder and water availability (Thornton, 2008). In addition, the changing composition of herds by introducing newly reared animal breeds, improving animal feed by growing fodders crops and adapting to new feeding strategies like cut and carry and stall feeding system which are popular in Tanzania and Uganda among pastoral farmers are practiced to cope and adapt to effects of climate variability (Kristjanson, *et al.,* 2012).

In Botswana, similarly, pastoral farmers at household practice coping strategies by shifting grazing and borehole rotation, water transportation to dry area in the dry season, herd separation to avoid over grazing on less good rangeland, pollarding to maintain the tree cover and regularly between kraals as existing coping strategies being used to environmental challenges (Stringer *et al.,* 2009). Similar, in the northern part of Zimbabwe, most of the pastoral and small scale farmers had reducing the size of cattle at house hold level, cross breeding mechanism to breed that can cope despite the continuous increasing heat and change of temperature and water availability (Mubaya, 2015).

2.4.3 Zambian Perspective

In the Zambian context, many pastoral farmers in the country have used variety method to cop to effects of climate variability. One of the major strategy being used by pastoral farmers is cross breeding of traditional and western livestock in order to suit the environment which has been popularised in some commercial farms in Namwala and Chisamba areas. The use of local traditional medicine to treat livestock from diseases, protecting the land from over grazing, water from boreholes, human made dams using water from the Lake Kariba and other local streams and herd management are common. In addition, livestock is shared among family members who stay in different places but within the district (Sichingabula, 1998). In this regard, it reduced overgrazing and over-crowding of livestock in one area.

According to FAO (2012) revealed that pastoralist had utilised pastoral mobility as one of the existing coping strategy to effects of climate change and variability. This is similar to other countries around the world such as in Australia, United State of America (USA), Europe, Ethiopia, West African countries, Sudan and Kenya were pastoral mobility was widely practiced (IPCC, 2007). Similarly, Nyanga (2015) also revealed that pastoral mobility was common among pastoral farmers in Namwala District who are involved in changing of the environment to adapt to the changing climatic season.

2.5 Gaps in the Literature Review

The study would bridge the knowledge gaps that exist on the available literature which does exist on the perception of climate variability on pastoral farming among pastoral farmers in Zambia, Africa and World perspective. Prior studies have concentrated much on the perceptions on the impact of variability on crop farming and not pastoral farming. In this regard, the study will provide clear understanding of pastoral farmers on impact of climate variability from 2001 to 2016 in Sinazongwe which would be help identify proper measures to solve the problems. The other challenges is that studies does not provide clear information if the pastoral farmers understand the climate variability in their local context thus giving different views depending to the experienced they have faced over time in the area of the study.

In this regard, the above literature reviewed has serious knowledge gaps about the existing coping strategies among pastoral farmers from the Global, Africa and Zambian perspective in which this study intend to contribute to local area by increasing climate variability knowledge

among pastoral farmers. Similar understanding is that pastoral farmers has little or inadequate knowledge on how best they can cope and adapt to severe impact of climate change that is affecting most part of the country and around the world. Less attention has been paid to reduce the challenges being faced as a result, effects of climate change and variability had been harsh over the long period of time. This had led to loss of pastoral farming industry in the country previous which was regarded as the best contribution to the economy. Lack of awareness, participation and programme among the local people in which there are practicing unsustainable measures to protect and enhance the coping strategies. It was rigid among the local people as a result of culture belief and practices has led them not to apply better ways only practising tradition method which are not relevant and applicable to address the effects of climate variability.

Summary of Literature Knowledge Gap

1. There is limited and little literature on the perceptions of pastoral farmers on effects of climate variability on pastoral farming at Global and African perspective.

2. Prior studies such as Sichingabula (1998) in Zambia and Thornton (2010) in Southern and East Africa adapted technical dimension and not educational strategy. In this regard, there is lack of community participation and involvement, collaboration, and engagement for situated learning.

3. There is little knowledge and understanding on the effects of climate variability among pastoral farmers in Sinazongwe District.

4. There is little literature on the local existing coping strategies in the Zambian perspective. These includes Mubaya (2015), Muchanga (2011) and IPCC (2007) for pastoral farmers to increase their adaptive capacity to climate variability.

5. Prior studies have concentrated much on effects of climate variability to crop farming than pastoral farming in Zambia and leaving out the pastoral farming industry.

6. Prior studies conducted around the world have not propose or introduce education strategies such as Community Based Education, Climate Change Education Programme and Environmental Learning Programmes or studies as an alternative and sustainable measures to address effects of Climate Variability on pastoral farming. Muchanga (2011) proposed a climate change learning model for small scale farmers in Lusaka Province for both Rural and Urban community. The model was to general and did not specific focus on pastoral farmers.

CHAPTER THREE

DESCRIPTION OF STUDY AREA

3.1 Introduction

In addition to the introductory in chapter one and literature review in chapter two which reviewed the perception of pastoral farmer to effects of climate variability in the last 15 years from 2001 to 2016, effects of climate variability on pastoral farming, existing-coping strategies among farmers and adaptive capacity. This section focused on spatial description of the study area were the research problem was concerned or taking place. The study explained the physical description such as the size of the area, climate characteristics and the geographical structure. The social-economic characteristic of the study area includes the population, economic activities, education and gender just to mention a few. The chapter presented reasons for choosing Sinazongwe District as study area. The proceeding section physical-characteristics of the study areas of Sinazongwe District.

3.2 Physical Characteristics

This section outline the physical characteristic of Sinazongwe District of Southern Province which was the selected study area. It also explained the geographical location on the map of the Zambia, the local vegetation and climatic characteristics such as weather, temperature and rainfall patterns in the area.

3.2.1 Location

The study was undertaken in Sinazongwe District situated in the South-East of Southern Province and it is one of the remote rural Districts in Zambia. The District is located in the Zambezi Valley part of great East Rift Valley and it extends from longitude 26° 43’ E to 27° 45’ E and latitude 16° 50’ S to 18° 00’ S (Zambia Meteorological Department (ZDM), 2010). The District shares its borders with Choma District to the west, Gwembe District to the North and Kalomo District on the South Western border that comprises of two Chiefdoms namely Chief Sinazongwe and Mweemba. In the South, lays the national boundary with Zimbabwe through Lake Kariba. The area covers approximately about 4200 square kilometres and distance of 220 km from Lusaka and 180 km from Livingstone (CSO, 2011). The approximated altitude of elevation above the sea level is 537 meters (ZDM, 2010).

3.2.2 Location of Zones in Sinazongwe District

Sinazongwe District has five geographical Zones as outline in the graph below. The names of the Zones consists of Maamba, Mweemba, Sinazongwe, Sinazeze and Buleya Malima**.** The Figure 3.1 indicated shows the boundary of Sinazongwe District and Zones.

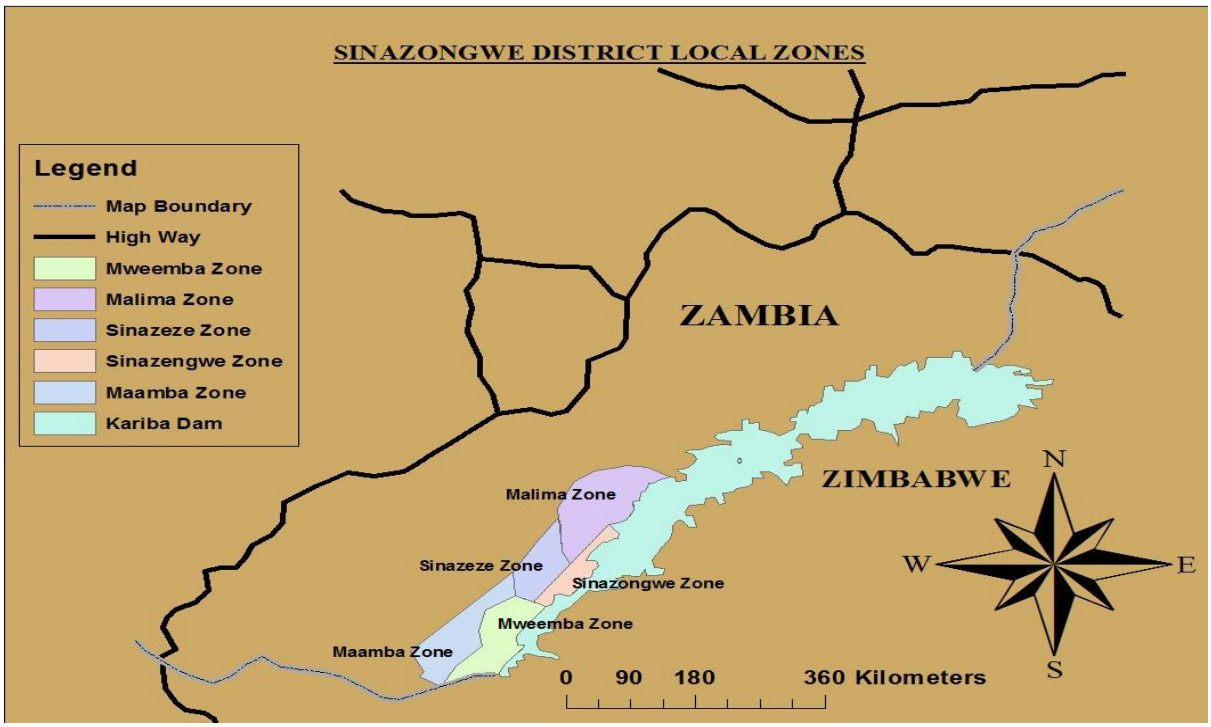

Figure: 3.1 Location of Zones in Sinazongwe District

Source: (CSO 2010 and ZMD, 2008).

3.3 Climatic Characteristics

The climatic characteristic of Sinazongwe District has continued to change overtime due to Climatic conditions being experienced in most part of the country. The daily mean temperatures varies but within the range of 20 to 25°C average temperature every year. According to Zambia Metrological Department (2010) a report indicated current trend in the near future is like to change and expected to rise due to the global climatic change and variability. During the summer, the actual temperatures rises from the normal to 40 °C were it becomes very hot in the area (CSO, 2010). Rainfall pattern are unpredictable and usually less than 700 mm and in some years there was hardly any. The weather in Sinazongwe District especially in October was the warmest average temperature of 36.7 °C plus at noon than other months. In June and July the area experienced the coldest average temperature of 10.8 °C especially at night (Sichingabula, 1998).

Sinazongwe District had no distinct temperature seasons like some other part of the country which had been changing over-time were the temperature was mostly relatively constant during the year. Furthermore, it had been reported that temperatures drop sharply at night and winter had some frost days with the coldest month most often being July. The month of August almost every year in the district experience the driest and increase in temperature. In addition, the month of September is on average with most sunshine and rainfall and other precipitation peaks around January. The other contribution factor of the climatic characteristic condition was due to the locality in the valley in the Zambezi escarpment.

3.3 Social-Economic Characteristics

The increasing population in the District according to figures given in the Central Statistical report of 2010 indicated that in 1990 to 2000 the different increased about 10000 and between 2000 to 2010 the population also increased by 21163. Sinazongwe annual population growth rate is below the provincial growth rate and current stands at 1.2 percent (CSO, 2014). The District is an elongated area situated at the very Southern part of Zambia and the ethnic groups of Sinazongwe District are the Valley Tonga. Recently the area has seen the rise of other ethnic group such as Lozi, Bemba, and many others coming to Sinazongwe as a result of the growing economic activities. It is a mountainous District with small pockets of settlements in the lowlands. The location of the District is at the vortex of major roads leading to cities, Maamba, Choma, and Malima influencing the development of it into a rest stop for travellers. The District is mainly inhabited by people whose socio-economic statuses are low. In this regard, the major economic activities includes mining, small scale farming, irrigation, fishing, tourism, quarrying, road side business, beer brewing and among others (CSO, 2014).

3.4 Selection Criteria of the Study Area

The effects of climate variability in Sinazongwe District was attributed as one of the major causes on the decline of pastoral farming among the local people. It was known that, Sinazongwe District in the past was regarded as one of the haven or the land of pastoral farming in the country but in the last two decades, the area has perceived an increase in loss of livestock. The District was chosen as a result of being one the mapped area facing severe effects of climate variability affecting the agriculture sector in Zambia. Therefore, the proposed CCEP can contribute positively in addressing the challenge by educating the pastoral farmers to

increase their adaptive capacity. As observed, the area has had faced challenges such as reduction or shortage of water, increase in drought occurrence, increased rainfall variability such as shorten rainy-season and delayed rain-season or on-set rainfall, increase in animal diseases and pest, lack of good pasture and temperature variability that led to the selection of the area.

The study area could provide the best information necessary to address the problem by increasing awareness and knowledge among pastoral farmers through a proposed educational programme. The study area was more accessible with good roads, the researcher's home and easy to collect information from selected respondents as a results of clear understand of the local language spoken. With changing economic perspectives in the country, it was convenient to carry out the study without financial constrain within the normal time frame to collect the data in a short possible period using the appropriate data collection tools.

CHAPTER FOUR

METHODOLOGY

4.1 Introduction

This chapter gives us a precise outline of the method and procedures which were undertaken to facilitate the accomplishment of the study. It would start by explain the paradigmatic orientation, research design and reason for adopting it in this study. Thereafter, this chapter would explain the population target, sample procedures and sampling size and research instrument which were used to collect data and reasons for choosing them.

4.2 Paradigmatic Orientation

A paradigm is defined as the "basic belief system or worldview that guides the investigator" (Guba and Lincoln, 1994, p. 105). The study adopted the post-positivist paradigm which emphasized the importance of multiple measures and observations. Further, each of which may possess different types of error, and the need to use triangulation across these multiple error sources to try to get a better information and understanding on what's happening in reality (Cresswell, 2010). Post-positivist also believes that all observations are theory-laden and that scientists (and everyone else, for that matter) are inherently biased by their cultural experiences, world views, and so on. A post-positivist believe that it’s not a cause to give up in despair, however just because the world view based on experiences and observation.

Within post positivism, critical realism is a specific philosophical perspective employed to guide the thinking of the study. According to Bhaskar (1997) critical realism as a philosophy of social science (critical naturalism) that intends to describe an interface between the natural and social worlds. Critical realism involves creating knowledge with critical thinking and decision being made in order to solve current problem in the society. It was adopted in order to create knowledge and propose an educational strategy (CCEP) for pastoral farmers to increase their adaptive capacity toward effects of climate variability on pastoral farming through sharing perceptions, experiences and observations with respondents.

Ontologically critical realist believed that there is reality that exists outside human thinking. According to Sayer (1992) ontological critical realist develops knowledge neither wholly continuously as the steady accumulation of facts within a stable conceptual framework, nor discontinuously, through simultaneous and universal changes in concepts. There was necessity

in the world objects whether natural or social necessarily with particular powers or ways of acting and particular susceptibilities on how knowledge was created and human think toward the existence of reality (Cresswell, 2002). The world is differentiated and stratified, consisting not only of events, but objects, including structures, which had powers and liabilities capable of generating events (Sayer, 1992). These structures may be present even where, as in the social world and much of the natural world (Archer, 1998).

Generally, critical realists uphold the existence of socially created realist through fallible as the world exist outside human thinking. The researchers uses multiple methods of data collection to try and get it right about the world (Cresswell, 2002). Therefore, the researcher was critical when analysing and interpreting pastoral farmer's views related to the study which were collected. The good questions were used to stimulate the selected respondents to provide or give correct information essential for the study. In this study, photograph and observation techniques also provided clear evidence and data interpretation to the findings. Therefore, critical realism was a very cardinal philosophy that brought out the most significant existing reality within the local context such as on how farmers were facing the challenges, what coping strategies they adopted to increase their adaptive capacity and the appropriateness of education to address effects of climate variability on pastoral farming.

Epistemologically, critical realist is involved as the studying of knowledge, how knowledge is created in the world, questions about what knowledge is all about and how knowledge is possibly studied (Archer, 1998). The critical realist claims that knowledge is acquired through experiences and observation within the world through involving of different methods in figuring out the truth about the knowledge which is socially constructed or interpreted by the human thinking of the person (Cohen, 2011). In addition, epistemological critical realism also attempts to explain the origin and nature of knowledge and to investigate the methods for learning, the scope, integrity and limits of human understanding (Patton, 2001). In this study, a proposed climate change education programme for pastoral farmers could be used and utilised to create knew knowledge and foster in addressing the effects of climate variability. This can depend on community interaction, learning process and local participation. During the data collection, information was gathered through the conducted focus group discussion, participant observation, direct observation and semi-structured interviews among selected respondents.

Axiological realism is the study of the reality of international relations derived from a minimal essentialism of human nature (Patton, 2001). It can also be defined as the study of values of knowledge and things (Fox, 2009). According to Cohen (2011) stated that axiology is divided into topics such as ethics and aesthetics. Ethics involves the principles of moral and rules to be guided during the data collection period. A critical realist examine the relation of individual's conduct in the society, social agreements and organizational values of what is supposed to be done at the right time to improve the well-being of the person and the community.

Aesthetics encompasses the studies of standards, judgments, feelings, deals with the notion of beauty and the philosophy of arts (Fox, 2009). The application of axiology was used to provide the significance on the understanding of the perceptions toward the effect of climate variability, how to address the effects of climate variability, utilising the coping strategies and then the proposed programme for pastoral farmer. In views of the above, pastoral farmers could apply correct strategies and acquire information on how to cope and adapt in order to reduce their vulnerability to effects of climate variability.

4.3 Research Design

According to Merriam (1998) research design is a plan on how a study can be conducted or a detailed outline of how an investigation will take place. A research design provide series of sign post to keep one in the right direction to correct information (Patton, 1990). The study employed a single case study with a purpose to understanding the essence of a phenomenon by examining the views of people who experienced it. Hence, pastoral farmers and local leaders were selected since they experienced the effects of climate variability. The study provided the depth understanding on participant's perceptions on the effects of climate variability on pastoral farming, effect of climate variability on pastoral farming, coping strategies and proposing an educational strategy for pastoral farmers to increase their adaptive capacity.

4.4 Population Target

The target population comprised of people practicing pastoral farmers and local leaders in Sinazongwe District which consists of 20,722 household (CSO, 2010). Sinazongwe District has about 6,500 estimated household of pastoral farmers and it's consists of low density in the Northern part of and medium density in the Southern part that lies near the coastal area to Lake Kariba. In this study, more representative data were selected from the Southern part than in

Northern part because of noticed experiences on the effects of climate variability on livestock. Therefore, the study targeted pastoral farmers, officers from the Ministry of Agriculture and Livestock, Community leaders, Local ward councillors and Headmen.

4.5 Sample Size

The sample size is defined as a total number of respondents selected to participate in the research study by collecting relevant information (Cresswell, 2007). According to Central Statistics Office (2010) a report indicated that, about 6500 are pastoral farmers in the District and others are engaged in crop farming, mining, business and fishing. The sample size were seventy (70) that participated generated from all the Zones of Sinazongwe District. The selected number of participants (pastoral farmers, leaders and experts) was adequate to correct adequate information required for the study. This included ten (10) expertise from the Ministry of Agriculture and Livestock in Sinazongwe District, Fifteen (15) local leaders selected from all five zones and forty-five (45) local pastoral farmers. The collected data was easily presented and analysed within the short time due to the number of respondents selected. The number was appropriate since the study was purely qualitative and not quantitative approach or mixed approach.

4.6 Sampling Design

Sampling procedure refers to the part of the study that indicates how respondents would be selected to be part of the sample size (Cresswell, 2003). This study used non-probability sampling method which involved convenient purposive sampling, heterogeneous purposively sampling and expert purposive sampling were used to determine the total sample size.

4.6.1 Convenient sampling

According to Patton (2001) convenient purposive sampling is a procedures were a sample is chosen from the people who are available to participate in the research study. This sampling method was employed or selected to gather or collect relevant information at the right time depending to the request of the respondents to be interviewed. The sampling was applicable due to the fact of little time available and getting correct information within the short period of time while other sampling techniques requires more time.

4.6.2 Heterogeneous Purposive Sampling

Heterogeneous purposively sampling refers to the selection of respondents both male and female having or facing the same characteristic (Cresswell, 2003). The preference of the above sampling was based toward pastoral farmers from the two chiefdom of Sinazongwe District such as Chief Mweemba and Sinazongwe. The heterogeneous purposive sampling was adopted because the perceptions of respondents, effects of climate variability, coping strategies were understood from both male and female pastoral farmer's representative who faced the same problem for a long time but had diverse information, interpretation and understanding of the challenge faced over the last two decades.

4.6.3 Expert Purposive Sampling

Expert sampling is a type of purposive sampling technique that is used when your research needs to glean knowledge from individuals that have particular expertise. In this regard, particular expertise that are being investigated form the basis of your research, requiring a focus only on individuals with such specific expertise appropriate to the study. In view of this, expert sampling is particularly useful where there is a lack of empirical evidence in an area and high levels of uncertainty, as well as situations where it may take a long period of time before the findings from research can be uncovered (Cresswell, 2003). In this study, the expert purposive sampling was used to collect data from selected government workers such as Veterinary and Agriculture officers in Sinazongwe District to provide the necessary information on pastoral farming such as the effects of climate variability and coping strategies being employed to increase their adaptive capacity.

4.7 Data collection tools

The study used both primary and secondary data as collection tools. Primary data collection is the collection of information using different approaches through interaction with the respondents. This can includes interviews, workshops, seminars, focus groups, observations, photographs and many others (Creswell, 1994). In this study, primary data collection tools included semi-structured interviews, focus group discussion, participant observation, direct observation and photographs which were employed to collect information from the selected respondents.

Table: 4.1 Data Collection Tools

DATA COLLECTION TOOLS			
S/N	**DATA COLLECTION TOOL**	**METHODS OF COLLECTION**	**TOOL OF COLLECTION**
1	PRIMARY DATA COLLECTION TOOL	Semi structured interviews	• Guided and unguided schedules
		Participation observation	• Note taking
		Focus group Discussion	• Photographs • Note taking
		Non-participate observation	• Note taking • Photographs
		Direct Observation	• Photographs • Note taking
2	SECONDARY DATA TOOL	Documents, reports, journals, magazine, newspapers and thesis	• Reading • Reviewing

Source: (Field data, 2017).

4.7.1 Semi-structured interviews

According to Berg (2007) semi-structured interviewing was best used when you won't get more than one chance to interview someone and you would be sending several interviewers out into the field to collect data. The semi-structured interview guide provided a clear set of instructions for the interviewer to acquire reliable and comparable qualitative data from the field (Cohen, 2011). In this context, the method was utilized in order to collect data from the identified and selected participants. Therefore, the selected participants were visited in their household at an appropriate time and interviews were conducted. It was used to collect data on the perceptions of pastoral farmers on the effects of climate variability, effects of climate variability on pastoral farming, coping strategies to cope and adapt to the effects of climate variability and proposing of CCEP to address the effects of climate variability on pastoral farming. The interviewer and participants were engaged in a formal interview allowing informant's freedom to express their views in their own terms about the topic or focus of the study.

4.7.2 Direct Observation

Direct observation is defined as the practice of examining or watching places, people, or activity without interfering or taking part in what's going on (Berg, 2007). This technique was relevant to the study which viewed and observed the effects of climate variability on pastoral farming and how pastoral farmers were coping or adapting to the problem. It was also used in knowing the coping strategies being utilised among pastoral farmers to increase their adaptive capacity. The recording of information in this technique was done with a notebook and pencil and phone recording as well as photographs were taken on important area or site. The method was appropriate because pictures were taken from different places showing the effect of climate variability in Sinazongwe such as drying of streams and BQ vaccinations programme in Maamba Zone of Sinazongwe District.

4.7.3 Participant Observation

Participant observation involved the researcher by living in the community being studied, participating with individuals, observing and talking with them and interpreting the situations observed. The researcher is the main instrument of data collection, and shares in the lives and activities of those being studied by learning their language and interpreting their behaviour (Cresswell, 2003). Participants' observation involves examining social behaviour as it occurs rather than as it is reported through interviews. This approach or method always take place in community settings and in locations thought to have some relevance to the research questions. During the data collection, many places were visited to observe activities being employed by pastoral farmers such as BQ vaccination areas, grazing places and sources of water.

This method is distinctive because the researcher approaches participants in their own environment rather than having the participants come to the researcher. According to Mariano (2001) participant observation also involves the researcher immersing him or herself in the daily lives and routines of those being studied. This often requires extensive work in the setting being studied and it is generally called fieldwork. Observation method provide an insight into the behaviour patterns and social organizations that operate and constitute a particular bounded system or case (Cresswell, 2003). During data collection, a number of villages and household from February to August 2017 were visited both the wet and dry season to understand the challenges faced and measures being used by pastoral farmers in that particular time. In this regard, participant observation provided clear experiences, information and responses to achieve the objectives of the study.

Generally speaking, participant observation was employed in trying to learn what life is like for an insider while remaining, inevitably, an outsider. While in these community settings, the researchers make careful, objective notes about what they see, recording all accounts and observations as field notes in a field notebook (Patton, 2001). During the data collection, informal conversation and interaction with respondents were important components of the method and relevant information from the field was recorded. In this study, the researcher participated in some activities such as treatment of livestock from diseases, animal mobility control and taking animals to drink safe clean water.

4.7.4 Non-Participant Observation

According to Patton (2001) a research technique whereby the researcher watches the subjects of his or her study with their knowledge, but without taking an active part in the situation under scrutiny. The study used or employed the non-participant observation method collect information as a way to examine the effects of climate variability and coping strategies. In this regard, many places from all the Zones were visited or toured to get depth information and experiences among pastoral farmers both in the dry and wet season from January to August 2017 in Sinazongwe District.

4.7.5 Focus Group Discussion

A Focus Group Discussion (FGD) is a type of group interview were a moderator (working for the researcher) leads a discussion with a small group of individuals such as students, teachers, teenagers, farmers and many others targets to examine, in detail, how the group members think and feel about a topic (Cresswell, 2011). The study conducted two focus group discussion among the selected respondents and was held in Maamba and the other one in Sinazongwe Zone. The conducted FGDs from Maamba after the BQ vaccination consisted of 8 selected pastoral farmers and veterinary officer who were purposively selected because they had the necessary information appropriate to the study and the other FGDs was also conducted in Sinazongwe Zone with local pastoral farmers and local leaders. This was done with the help of local leaders such as headmen, councillors in selecting respondents.

According to Cohen (2007) acknowledged the relevant of focus group discussion in qualitative research studies that, it is very economical on time, focused on particular issues and yield

insights that would not otherwise be available in a straightforward interview. It also involves by observation were it produces large amounts of data in a short period of time and be useful to triangulate with more traditional forms of interviewing. In the context of the study, the Focus Group Discussions (FGDs) was used to collect data from pastoral farmers, local headman and selected representative councillors in order to clarify and shade more light on their perceptions on the effects of climate variability, effects of climate variability on pastoral farming, coping strategies and the need to propose a CCEP to increase their local adaptive capacity.

4.8 Secondary Data

Secondary data collection refers to data that had been already collected and recorded by someone else or scholar and readily available from other sources (Zikmund, 2003). In this study, secondary data was obtained from dissertation, books, electronic data, report and many others from the University of Zambia library, Ministry of Agriculture, Ministry of Livestock and many others sources on the perception of pastoral farmers on the effects of climate variability. The effects of climate variability on pastoral farming, coping strategies to effect of climate variability on pastoral farming and proposing CCEP to address the effect of climate variability on pastoral farming.

4.9 Summary of Data Collection Tools

In this study, the data collection tools comprised of primary data tools such as semi-structured, focus group discussion, participant observation and direct or non-participant observation. Secondary data involved about reading and reviewing of relevant documents, journals and others sources in relation to the study. These various methods were adopted with a purpose of validating and reliability on the information that was collected. The adopted data collection tools were appropriate to answer the questions which was purely a qualitative study in nature.

4.10 Methods of Data Analysis

In this study, the method of data analysis comprised of primary and secondary data that was used to analyse the collected data from selected participants.

4.10.1 Primary and Secondary Data Analysis

Thematic analysis was used to analyse the primary and secondary data. Thematic analysis is used in qualitative research which focus on examining themes within the data collected (Rohana, 2010). Thematic analysis is used in identifying, analysing and reporting patterns (themes) within data. It minimally organises and describes your data set in rich ways or detailed (Braun, 2006). In this study, themes such perceptions, effects of climate variability, coping strategies and data on proposing a Climate Change Education Programme for pastoral farmers were generated. In this regards, data collected from expert, local pastoral farmer, headmen and councillors was used as primary data.

4.11 Methods of Data Validation

According to Angen (2000) triangulation is a process of using multiple data sources in an investigation to produce a deeper understanding of a research topic (Patton, 2001). Data triangulation refers to a method used by most qualitative researchers to check and establish validity in their studies by analysing a research question from multiple perspectives in order to arrive at consistency across data sources or approaches (Cohen, 2000). Between-methods triangulation was employed to validate the data collected from multiple sources, since the study was purely qualitative. Data triangulation interpreted the primary data collected from multiple sources such as semi-structure interviews, photographs, focus group discussion and observation. On the other hand, secondary data was involved in gathering of similar information from reviewed documents, reports and many other relevant literatures. Henceforth, it was significant and appropriate to test the uniformity of the findings obtained through different instruments and increased the chances to control or at least assess some of the threats or multiple causes that could influencing the results.

4.12 Analytical Framework

Analytical framework is defined as a model that helps explain how a certain type of analysis would be conducted (Cresswell, 1994). *It u*nderpins, supports and guides the collection, collation, storage and analysis of data by identifying key analytical outputs and products at each step of the analysis. It also provide a ways to organise what data to be collected, serves as a communication tool and a driver for collaboration between humanitarian actors and it could be used as a reference throughout the process (Cohen, 2011). In addition, it identify what information could be useful for analysis and what could be discarded and how to analyse it. In this study,

analytical framework was applicable to analyse the data collected from informants and selected participants on their perceptions toward climate variability, effects of climate variability, coping strategies and proposing an education programme to increase their adaptive capacity and therefore, the Figure 4.1 shows the analytical framework of the study which involved how data was analysed.

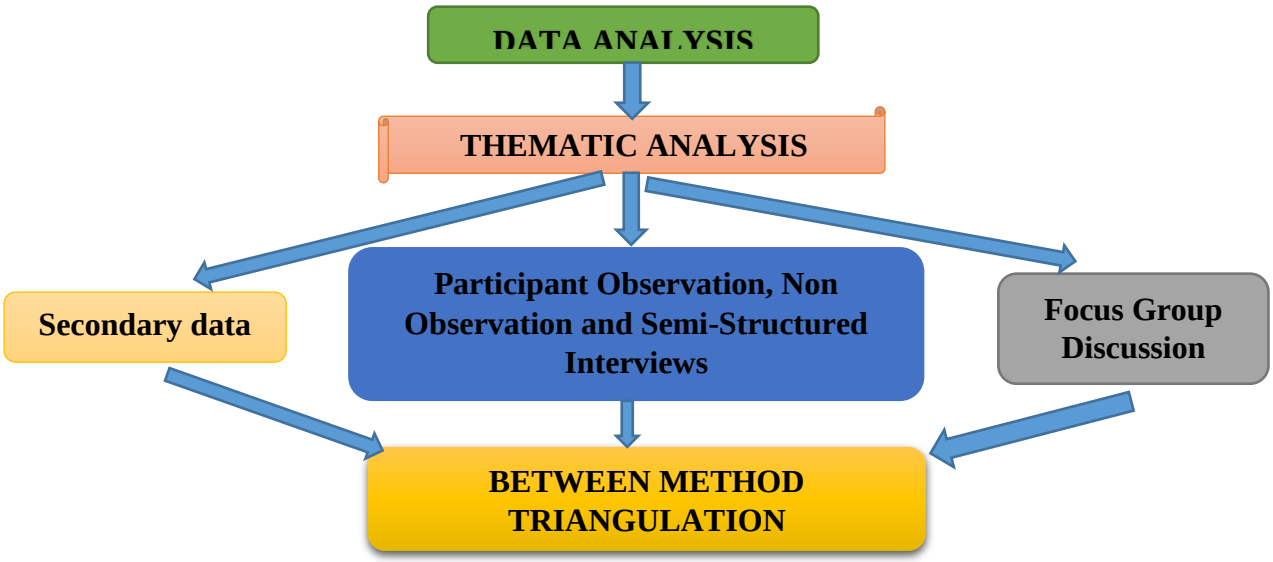

Figure 4.1: Analytical Framework on the effects of Climate Variability on Pastoral Farming in Sinazongwe District.
Source: (Field data, 2017).

4.13 Limitation of the Study

The current study on the effects of climate variability on pastoral farming is one of the newly emerging issues in the field of Environmental Education (EE). Agriculture in Zambia is the most dependable sector that contribute positively to the economic growth of the country and reducing poverty levels. Notably, this sector faces serious climatic conditions affecting it growth or contribution to the national development leading to decline or loss in livestock production. It could have been appropriate to include all pastoral farmers to collect data and gather diverse views but due to limited or inadequate time, resources and seasonal period, only few selected respondents or participants were sampled for collect data to represent others. The researcher selected representatives from each key areas to represent other pastoral farmers. There was little literature on the perception of pastoral farmers at Global and Zambian perspective, effects of climate variability on pastoral farming and existing coping strategies among pastoral farmers at global and Zambia perceptive respectively and therefore views from the respondent were utilised related to the study.

4.14 Delimitation of the Study

The study on the effects of climate variability on pastoral farming in Sinazongwe District could not be generalised to other areas but would be relevant to the particular study area. This means that the data collected was only applicable to the areas due to the nature and locality of the environment. The study could have been desirable to cover the whole Southern Province but due to limited time and resources it was only conducted among selected pastoral farmers in Sinazongwe District. The study only targeted 70 respondents but it was necessary to cover the whole pastoral farmers, thus the research cannot be generalised.

4.15 Pilot Study

A pilot study is defined as "a small-scale test of the methods and procedures to be used on a larger scale" (Porta, 2008). The fundamental purpose of conducting a pilot study was to examine the feasibility of an approach that is intended to ultimately be used in a larger scale study. A pilot study provided an opportunity to develop a consistent practices that would enhance data integrity and the protection of human subjects in the study area (Cresswell, 2003). The pilot study include the refinement of source documentation, informed consent procedures, data collection tools, regulatory reporting procedures, and monitoring/oversight procedures, especially when multiple sites and investigators are engaged in the study. In this study, the pilot study was conducted for the period of one month in Sinazongwe District from the third week of December 2016 to third week of January 2017. During the pilot study, pastoral farmers were asked questions on their perceptions on the effects of Climate Variability (CV) on pastoral farming (2001-2016), the notable effects of climate variability on pastoral farming, existing coping strategies and the appropriateness and relevant of developing a CCEP to address the effects of climate variability on pastoral farming.

4.16 Ethical Consideration

According to Maxwell (2005) ethics refers to the quality of research procedures, with regard to their adherence to professional, legal, and social obligations to the research participants. These guidelines deal with voluntary participation, no harm to respondents, consents letters, anonymity and confidentiality, respect, culture norms. In view of the above, consent letters were collected from the school, supervisors and permission from local headmen, pastoral farmers, councillors and experts in the area was granted to collect data. In this study, any possible harm was avoided to the selected participants such as photograph was only taken with

their consent. During interviews and focus groups discussion, no silly or uncomfortable, irrelevant questions that could cause anonymity or embarrassment and uncomfortable about them and upholding of their culture norms. Confidentiality was assured to all participates were no names would be disclosed and they were informed that the study was purely for academic purpose only.

4.17 Chapter Summary

This chapter summary explained the methodological procedures or methods used. The chapter outlined the philosophical paradigmatic and provided its application to the study. A detailed steps taken from the research design through data collection, analysis, sampling procedures, sample size, data analysis, data validation methods and ethical considerations that were taken in the study.

CHAPTER FIVE

PRESENTATION OF FINDINGS

5.1 Introduction

This chapter present the findings of the study proposed a Climate Change Education Programme (CCEP) to address the effects of Climate Variability on Pastoral Farming in Sinazongwe District of Southern Zambia. The findings below are presented according to the study questions. The research question of the study were as follows:

1. What are pastoral farmer's perceptions on the effects of Climate Variability on Pastoral Farming from 2001 to 2016 in Sinazongwe District?
2. What are the effects of Climate Variability being faced in Sinazongwe District?
3. What are the Coping Strategies being used by pastoral farmers in Sinazongwe District?
4. How can a Proposed Climate Change Education Programme address the effects of Climate Variability on Pastoral Farming in Sinazongwe District?

5.2 Demographic Characteristics of Respondents

The socio-economic characteristics such as gender, educational level, occupation, monthly incomes, duration of respondents stay, the approximately number of livestock per household was investigated in order to understand the background information. These were studied or undertaken to provide the general characteristics of the target population.

5.2.1 Gender Distribution of Respondents

The Gender distribution of respondents was important to understanding the effects of climate variability on pastoral farming being faced or experienced by both males and female in Sinazongwe District. It was also important to have diverse information on how pastoral farmers cope and adapt to the effects of climate variability and how an educational programme (CCEP) could be appropriate and increase their adaptive capacity.

Table 5.1: Distribution of Gender for Respondents

Sex	Frequency	Percentages %
Male	57	81
Female	13	19
Total	**70**	**100**

(Source: Field data, 2017)

The distribution of gender for respondents on Table 5.1 shows male pastoral farmers were the majority participants. The results show that fifty-seven (57) male were majority respondents representing eight-one (81%) while, the thirteen (13) female respondents representing nineteen (19%) were selected to participate in the study.

5.2.2 Educational Level of the Respondents

Table 5.2 shows that the most of the selected respondents from all Zones in Sinazongwe District had attained or obtained education.

Table 5.2: Education level of Respondents

Levels of Education	Frequency	Percentages %
Not been to school	12	17
Primary	9	13
Secondary	30	43
Tertiary	19	27
Total	**70**	**100**

Source: (Field data, 2017).

The educational level of respondents as shown in Table 5.2 that majority of participants had gone to school or attained education. As indicated in Table 5.2, it shows that nineteen (19) respondents twenty-seven (27%), attended tertiary education, thirty (30) respondents forty three (43%) attended secondary school, nine (9) respondents thirteen (13%) attended primary school and twelve (12) respondents seventeen (17%) did not attend any school.

5.2.3 Employment Status of Respondents

The occupation distribution of respondents was shown in Figure 5.1.

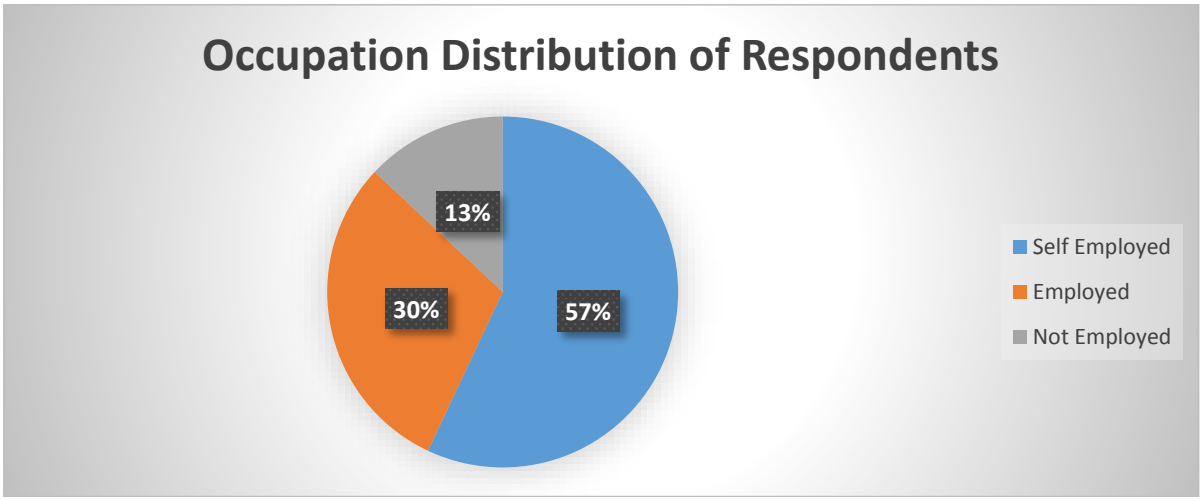

Figure 5.1: Occupations status of the Respondents

Source: (Field data, 2017).

The Figure 5.1 shows that forty (40) respondents fifty-seven (57%) were self-employed, twenty-one (21) respondents thirty (30%) were employed and nine (9) respondents thirteen (13%) were self-employed. The findings showed that majority of respondents were engaged in other activities such as farming, fishing, business and other as means to support themselves at household level.

5.2.4 Years Stayed in the Study Area

The number of years stayed by respondent in the study area as shown in Table 5.3.

Table 5.3: Years stayed in the study Area.

Years	Frequency	Percentages%
0-5	6	9
5-10	12	17
10-20	36	51
Above 20	16	23
Total	**70**	**100**

Source: (Field data, 2017).

As indicated in the Table 5.3, it showed the number of year's respondents had stayed. The findings shows that sixteen (16) respondents twenty three (23%) stayed for twenty (20) years

and above, thirty six (36) respondents fifty one (51%) stayed between ten (10) to twenty (20) years, twelve (12) respondents seventeen (17%) stayed for five (5) to ten (10) years and only six (6) respondents nine (9%) stayed for the period of five (5) years or less.

5.2.5 Estimated Number of Livestock at Household Level

The estimated number of livestock at house level among pastoral farmers in Sinazongwe District was presented as indicated in Table 5.4.

Table 5.4: Estimated Number of Livestock

Estimated Number of Livestock per household	Frequency	Percentages
0-20	11	16
20-50	16	23
50-100	28	40
Above 100	15	21
Total	**70**	**100**

Source: (Field data, 2017).

As indicated in Table 5.4, it showed that pastoral farmers had livestock at household level in Sinazongwe District. According to Table 5.4, twenty eight (28) respondents forty (40%) percent clearly indicated that per household about fifty (50) to hundred (100) number of livestock and sixteen (16) respondents twenty three (23%) about twenty (20) to fifty (50) estimated number of livestock per house hold. The findings indicated that, eleven (11) respondents sixteen (16%) indicating about Zero (0) to twenty (20) number and fifteen (15) respondents (21%) representing those above hundred per household.

5.3 Perceptions of Pastoral Farmers on Climate Variability from 2001 to 2016:

5.3.1 Climate Variability

As observed from Table 5.5, majority of the respondents had experienced climate variability on pastoral farming in all the selected Zones of Sinazongwe District.

Table 5.5: Responses on the Perceptions on Climate Variability on Pastoral Farming

Responses among respondents	Frequency	Percentages
Change of season	62	89
Not change of season	5	7
Normal	2	3
No response	1	1
Total	**70**	**100**

Source: (Field data, 2017).

The selected respondents from all the Zones in Sinazongwe District (Buleya-Malima, Sinazeze, Sinazongwe, Mweemba and Maamba) perceived the effects of climatic variability in the last fifteen (15) years (2001-2016) as shown in Table 5.5. The findings shows that sixty-two (62) respondents eight-six (86%) perceived or noticed change of season, five (5) respondents (7%) did not perceive or notice any change of season, two (2) respondents three (3%) noticed normal season and one (1) respondent one (1%) showed ignorance by not responding to the question.

5.3.2. Rainfall Variability

Table 5.6 shows responses of respondents on rainfall pattern in all the selected Zones of Sinazongwe District.

Table 5.6: Responses among Respondents on Rainfall Variability

Responses from respondents	Frequency	Percentages
Experienced variability	48	69
Normal rainfall	2	3
Low rainfall	3	4
High rainfall	2	3

Delayed onset rainfall	4	6
Shorten rain season period	11	15
Total	**70**	**100**

Source: (Field data, 2017).

As shown in Table 5.6, the majority of forty-eight (48) respondents sixty-nine (69%) experiencing rainfall variability, four (4) respondents six (6%) noticed of delayed onset rainfall, three (3) respondents four (4%) noticed of low rainfall. The results also indicated that two (2) selected respondents (3%) mentioned of having experienced normal rainfall. It also indicated that, two (2) respondents three (3%) noticed of high rainfall patterns and eleven (11) respondents fifteen (15%) noticed of shorten rain season period from 2001-2016.

The key informants among the respondents agreeing with the findings experienced in Mweemba Zone on the rainfall pattern change when asked on what they had experienced on the rainfall pattern in the area.

> *"Yes, rainfall patterns has drastically changed than it was previously. For instance in 2002 up to 2004 we experienced less rainfall and eventually a lots of animal (livestock) died due to lack of water. Furthermore, the respondents explained that, the rainy season used to start as earlier as September to October just for two to three weeks and it goes. Currently, rains has become periodical were rainfall comes or start around mid-December during Christmas period up to Mid-February".* (Pastoral Farmer (PF), February 2017, FGD).

The selected respondents stressed that un-stable rainfall patterns in the area had affected the rearing of livestock in which they had lack of water in the area. It was also revealed that, pastoral farmers who had stayed in the area for many years (20 years above) had experienced changes every year contributing to poor growth of livestock. This implies that the rainfall period had experienced variability such that rainfall period in the area had reduced were previously rainfall season was long starting early September to Mid-May before than now were rainfalls season had been shortened from Mid-December to end of March. These changes experienced by respondents (local people) had affected the growth of pastoral farming were reduced number of livestock have been recorded in the area.

5.3.3 Temperature Variability

The respondents were asked to state their perceptions on temperature change as one of the factors observed on climate variability as presented below on Table 5.7.

Table: 5.7 Responses among Respondents on the Perceptions of Temperature Variability

Responses from respondents	Frequency	Percentages
Experienced variability yearly	43	62
Low temperature	1	1
High temperature	23	33
Normal temperature	2	3
No response	1	1
Total	**70**	**100**

Sources: (Field data, 2017).

As indicated in Table 5.7, the result shows majority of forty-three (43) respondents sixty-two (62%) experienced temperature variability yearly in the last fifteen years (2001-2016), twenty-three (23) respondents thirty-three (33%) noticed of high temperatures were observed and keep changing every year. In addition, two (2) respondents three (3%) had observed normal temperature in the area, 1 respondent (1%) observed low temperature and another selected 1 respondent (1%) did not respond to the question on how they perceived the effects of Climate Variability on Pastoral Farming in Sinazongwe District.

Further, the interviewed pastoral farmers had experienced and observed temperature variability in the area than it was before. One of the key informant from Mweemba Zone was asked to provide his/her perceptions on the effects of climate variability on pastoral farming in terms of temperature variability and said the following:

> *"Okuno twapenga kupye kwaindilila kwa myaaka ilikumi amusanu a n'gombe zyamana kufwa loko. This could be translated as here we are suffering because of experienced serious temperature variability (heat) in the last 15 years."* (Pastoral Farmer, 2017, Interview).

5.3.4 Water Availability

The respondents were asked to state their perceptions on water availability as one of the factors observed in the area on climate variability as presented on Table: 5.8.

Table: 5.8 Responses among Respondents on Water Availability

Respondents responses	Frequency	Percentages
Observed water variability	42	60
Normal	6	9
Increase in water	3	4
Reduction in water	17	24
No responses	2	3
Total	**70**	**100**

Source: (Field data, 2017).

Table 5.8 indicated that forty-two (42) respondent sixty (60%) observed or experienced an increase in water variability in the last fifteen years period (2001 to 2016). The results also shows seventeen (17) respondents twenty-four (24%) perceived reduction in water. On the other hand, six (6) respondents nine (9%) perceived of normal water availability. In addition, three (3) respondents four (4%) mentioned of increase in water and two (2) respondents three (3%) did not give any response patterning to water availability.

The respondents had experienced shortage on the availability of water in all the Zones. During the observation, it was noticed that steams had dried up causing a serious shortage of water in the area. The findings showed that most of the animals had died as a results of shortage of water that had led to consume polluted water for a long time causing animal health. Pastoral farmers walk long distance searching for quality water especially in the dry season (May to October). Local pastoral farmers always utilised water from the well and borehole which was not adequate and some area not safe for drinking. The interviewed pastoral farmers who had stayed in the area for more than 10 years experienced loss of pastoral farmers as a result of lack of availability of water. In this regard, the perceptions of pastoral farmers on water availability from 2001 to 2016 from all the zones are almost similar. On the other hand, pastoral farmers who stay near the Lake Kariba did not face any problem.

5.4 Effects of Climate Variability on Pastoral Farming:

Effects of climate variability on pastoral farming in Sinazongwe District was being experienced and noticed among the selected respondents in the last fifteen years (2001 to 2016). In this regard, pastoral farmers and selected respondents were interviewed on the effects of climate variability on pastoral farming. Some of the questions were asked to the respondents in order to attempt the objective of the study. The following questions included; what are the effects of climate variability on pastoral farming you are facing? Which one is the most common effect of climate variability on pastoral farming?

Table 5.9 clearly shows the effect of climate variability on pastoral farming in Sinazongwe District for the period of fifteen years (2001 to 2016). The experienced effect of climate variability among pastoral farmers from all Zones includes temperature variability, rainfall variability and change, increase in outbreak of diseases, occurrence of floods and drought, observed poor pasture, poor quality and scarcity of water as outlined (Table 5.9). The selected respondents also mentioned how experienced every year concerning the effects of climate variability on pastoral farming.

Table 5.9: Effect of Climate Variability in Sinazongwe District (2001-2016)

Season	Experienced Effects of Climate Variability among Pastoral Farmers.
2000/01	Increase in floods, temperature change, poor pasture, increase in the loss of livestock
2002-03	Occurrence in droughts, increase in the death of livestock, change in rainfall patterns, diseases and pest, temperature increase
2004-06	Heavy rainfalls, heat waves, poor pasture growth, high temperature, change in timing of rainfall, water scarcity and diseases and pest outbreak, extreme loss of livestock
2007/09	Floods occurrence, increase in temperature, loss of livestock and short cold season
2010-11	Increase in floods, pasture growth affected, loss of livestock was experienced and temperature increase.
2012-2014	Short cold season, long hot season, flash of floods, increase in temperature and delayed rainfalls
2015-2016	Below average rainfalls, onset rainfall, poor water quality and quantity, increase in temperature, heat waves, diseases and pest increase/ outbreak loss of livestock was experienced in some areas.

Source: (Field data, 2017).

5.4.1 Shortage of Water

The finding showed that dying the of water bodies such as local streams and dams was one of the climate variability being faced among pastoral farmers in the Sinazongwe District. In this study, respondents from all the five Zones of Sinazongwe District mentioned that the effect of climate variability has caused to the loss of animals in the area. During the interviews conducted in the study area, pastoral farmers in the Northern part of Sinazongwe District had experienced severe lack of water scarcity due to the mountainous location. Further, most of the local streams dries up so early causing water shortage. During the wet season, most of the local stream flows direct to Lake Kariba and animals had to walk long distances Therefore, animals or livestock walks long distances of about 15 to 40 kilometres in search of clean water. The results shows that most of pastoral farmers in the Northern Zones of Sinazongwe District had few boreholes and wells that provide water meant for livestock. On the other hand, pastoral farmers in the Southern Zones, always take their animals to the Lake Kariba since it was near and accessible without walking a long distance.

(a) Drying of a local stream in Sinazeze Zone (b) Drying of a local stream in Maamba Zone

Figure 5.2: The Shortage of Water in Mweemba and Maamba Zone.

Source: (Field data, 2017).

The Figure 5.2 shows the dying of water bodies in the area in Sinazeze and Maamba Zone. These photograph or pictures were taken during the direct observation of the Zone. During field visit between April and June 2017, selected local stream were visited to check on the availability of water.

During interviews and focus group discussion conducted, pastoral farmers and selected participants also explained that, the effect of climate variability were experienced in the last two decade. In view of this, pastoral farmers experienced an increase in the loss of livestock which was as a result of water scarcity, outbreak of animal diseases and pest, dehydration of animal, heat stress and starvation. The findings showed that Sinazeze and Maamba Zone had few pastoral farmers due to increased effects of climate variability. In addition, Sinazongwe Zone, it was indicated that there are few challenges concerning water because of the availability Lake Kariba.

In addition, the District Veterinary Officer had the following to say on water scarcity faced by pastoral farmers in Sinazongwe District;

> *"Most of the local farmers here depend on the rain-fed as the major source of water for animals or livestock. In dry season, pastoral farmers experience problem to manage their livestock due to increased shortage of water availability. These areas includes; Muziyo in Sinazeze Zone, Sinakoba, Sinakumbi and Dengeza in Mweemba Zones. In 2016, there was serious loss of livestock in the areas".* (District Veterinary Officer, 2017, Interview).

5.4.2 Outbreak of Animal Diseases and Pest

During the interviews and focus groups discussions, participants lamented that outbreak of animal diseases and pest occurs almost every year that is affecting the growth of pastoral farming. It was noticed that the increasing temperature and change in rainfall are the major contributing factors to the occurrence of diseases and pest. One of the Headmen in Sinazeze Zone mentioned that the area never used to experience outbreak of disease and pest in the past from 1980s to 1994. Since that time, the respondent bemoaned that there has been an increase in the outbreak of diseases. In 1996 to 2016, a period of ten (10) years, the area recorded an increase in the number of diseases such as anthrax, foot and mouth diseases, black leg, tick diseases, corridor diseases, elephantiasis and viral disease. Similarly, the pastoral farmers from Sinazeze and Mweemba Zone also mentioned the outbreak of diseases.

In the last two decades, from May-October every year, Mweemba Zone has been experiencing outbreak of animal disease and pest threatening the rearing of livestock and these effects are as a result of free movement of animals even in the affected ranges or parts. In the rainy-season

of 2015 and 2016, pastoral farmers experienced loss of livestock as a results of animal diseases and pest in Mweemba and Sinazeze Zone. Additionally, it was also reported of an increased loss of livestock in the last five years as indicated by respondents. Therefore, during the interviews, the District Veterinary Officer had this to say when asked on the effect of climate variability on pastoral farming in Sinazongwe District;

> *"As a District Veterinary Officer, there was un-stable rainfall precipitation in Sinazongwe District in the last 20 years. There is a decline of water and water quality especially in the Northern part of the District which consist of (Maamba, Sinazeze and part of Buleya Malima Zone) that has led to increased outbreak of diseases which includes anthrax, black leg and tick and mouth. (District Veterinary Officer, 2017, Interview).*

5.4.3 Occurrence of Floods

The area experienced severe floods that increased the vulnerability of livestock to effect of climate variability. In this regard, respondents mentioned that in rainy-season of 2008 and 2009, 2014 and 2015) the District experienced flush flood that led to an increase in the loss of animals. The respondents also revealed that flood were destroying the growth of grass or pasture as a result of heavy down pour of rainfalls. Moreover, Sinazongwe District receive normal rainfalls from January to March every year. In addition, floods contributed to the reduction on the quality of water, lack of pastoral mobility in search of greener pasture, increase in animal stress, diseases and pest, soil erosion and starvation.

5.4.4 Temperature Variability

The study showed that temperature variability was noticed and experienced in all selected Zones of Sinazongwe District. The major problem that was faced by pastoral farmers was the increased temperature and heat. Respondents mentioned that from the year 2010 to2016 temperature variability was changing and causing poor animal production, poor growth of pasture, increasing in animal heat stress and animal diseases and pests. One of the key informant alluded the following when asked about the effects of temperature variability on livestock.

> *"Banyama aba ba penga maningi alimwi zyafwa loko okuno akaambo kakupya kwaindilila chobeni kwinda myeka yainda okuno which can be translated as*

Livestock had suffered and had died a lot because of increasing heat and temperature than previous years in the area". (Pastoral farmer, 2017, Interview).

5.4.5 Loss of Quality Pasture

During interviews, respondents alluded that of lack or loss quality pastures for livestock. This was as a result of increasing of droughts or erratic rains or low rainfall and temperature variability. In dry season, respondents from the Northern Zones mentioned that animals or livestock suffer and walk long distances in search of greener pasture. Therefore, pastoral farmers take their livestock in overcrowding grazing areas risking them to livestock diseases and pest. The District Veterinary officer also mentioned that, the loss of good pasture in the area was a result of increasing temperature as observed in all the Zones as shown in Figure 5.3.

Figure 5.3: Poor Growth of Pasture

Source: (Field data, 2017)

Figure 5.3 shows the poor growth of grass which was taken during the dry season after crop harvest in Sinazeze Zone of Sinazongwe District.

5.5 Coping Strategies among Pastoral Farmers

The study was to determine the coping strategies among pastoral farmers that includes the awareness of respondents, coping strategies being practiced by pastoral farmers to cope and increase their adaptive capacity to effects of climate variability on pastoral farming.

5.5.1 Awareness among Pastoral Farmers

The selected respondents were asked whether they were aware or not aware of the coping strategies to cope and adapt to the effects of climate variability at household level. The findings are shown in Table 5.10.

Table 5. 10: Responses on the awareness on the Coping Strategies among Pastoral Farmers.

Responses of respondents	Frequency	Percentages
Aware	47	67
Not aware	20	29
Not Sure	3	4
Total	**70**	**100**

Source: (Field data, 2017).

Table 4.10 indicate that forty-seven (47) respondents sixty-seven (67%) were aware of the local coping strategies being practiced to cope and adapt to effects of climate variability on pastoral farming. This could be as a result of the level of education attained. The findings among respondents on the numbers of years stayed by pastoral farmers influenced the awareness, challenges and experiences in the last two decade. The findings showed that twenty (20) respondents twenty-nine (29%) were not aware of any coping strategies as a result of to lack of knowledge and poor literacy level among pastoral famers. It also indicated that, three (3) respondents four (4%) were not sure of being aware of existing coping strategies.

5.5.2 Coping Strategies

The finding shows the responses of respondents on the coping strategies among pastoral farmers being used or utilised to cope and adapt to the effects of climate variability on pastoral farming in Sinazongwe District as indicated in Table 5.11.

Table 5.11: Responses on the Coping Strategies among Pastoral Farmers

Coping Strategies	Frequency	Percentages%
Indigenous knowledge	4	6
Animal Mobility control	1	1
Veterinary/Agriculture services	18	26
Sinking of boreholes	11	16

Sinking of wells	1	1
Pasture control	1	1
Restocking of animals	2	4
Water Harvesting system	1	1
Early warning system	1	1
Keeping animals in the forest or shade	2	4
Sharing of livestock among families	6	9
Selling of Livestock	6	9
Engage in other economic activities	7	11
Provide foods (forage)	1	1
Free range grazing	1	1
Take animals to the Lake Kariba	6	9

Source: (Field data, 2017).

The results on Table 5.11 showed that majority of eighteen (18) respondents twenty-six (26%) from all the selected Zones used veterinary services as one of the major coping strategies among pastoral farmers to adapt and cope with the effects of climate variability on pastoral farming. These veterinary services offered by veterinary officers involves spraying of animals, Dip tank services, BQ vaccinations, Extension services and Inspection of disaster and emergency control. The study revealed that eleven (11) respondents sixteen (16%) mentioned of sinking of borehole as one of the coping strategy were livestock access water especially in drought seasons when streams dries up. Some of the coping strategies pastoral farmers utilised was by selling of livestock, taking animals to the Lake Kariba which is the major source of water and sharing of livestock among family members to reduce the number of livestock being kept at one place for easier management (herd management) as indicated in Table 5.11. the findings showed that four (4) respondents six (6%) also indicated that indigenous knowledge was being used were pastoral farmers such uses traditional medicines to treat animals as a way of addressing outbreak of diseases and pests being experienced especially during the wet seasons.

During interviews in Maamba Zone, one of the selected pastoral farmers mentioned that, livestock vaccine occurs once or twice in a year leading to an increase in the outbreak of diseases and pest. Therefore, it was reported that in the last five years, serious outbreak of diseases and pest was experienced among pastoral farmers were loss of livestock was noticed. In this regard, the common livestock diseases mentioned by selected participants includes Anthrax, Foot and Mouth Disease, Tick and Black Leg and Elephantiasis. Additionally,

veterinary services were not utilised among pastoral farmers for livestock treatment and vaccination that led to an increase in the loss of livestock. It was revealed that some pastoral farmers were able to buy medicine for themselves and managed to treat their animals as recommended by the local veterinary officers and local agriculture camp officers while the majority local pastoral farmers could not manage and became vulnerable to effects of climate variability on pastoral farming.

(a) Kamando in Siankodobbo Village of Maamba Zone (b) Veterinary Office vaccinating animals

Figure 5.4: Black Quarter Vaccine of livestock in Maamba Zone of Siankodobbo Village.
Sources: (Field Data, 2017).

The Figure 5.4 shows the BQ Vaccination in Siankodobbo village of Maamba Zone in Sinazongwe District. A local pastoral farmer mentioned that this method is commonly known as Kamando being used to treat livestock against diseases and pest.

Figure 5.5 shows the conducted FGD in Siankodobbo Village in Maamba Zone with pastoral farmers and the veterinary offices after the BQ Vaccination. The FGD comprised of seven (7) selected pastoral farmers, one (1) veterinary officer and the researcher. During the focus group discussion, pastoral farmers bemoaned of inadequate of vaccination services to control and manage the occurrence of livestock diseases. One of the key informant had this to say on the vaccination of livestock when asked;

> *"Sir, our challenge here is that there is inadequate of vaccinations to treat our animals. Most of the veterinary office carry out their work when there is an outbreak of diseases and not as recommended. They also mentioned that there*

was need for regular treatment of animals in order to reduce the vulnerability of livestock to diseases". (Pastoral Farmer, 2017, FGD).

Figure 5.5: Focus Group Discussion with Pastoral farmers and Veterinary Officer

Source: (Field data, 2017).

5.6 Proposing a Climate Change Education Programme (CCEP) for Pastoral Farmers:

The respondents were asked on the appropriateness of proposing a CCEP which could be used to address the effects of climate variability on pastoral farming farmers and the roles of stakeholders to the programmes.

5.6.1 Appropriateness of Proposing a Climate Change Education Programme

The respondents were asked to explain if it is appropriate to propose a programme to address the effects of climate variability on pastoral farming in the area. This programme could be necessity to provide awareness and knowledge among the pastoral farmers on how to cope and adapt to effects of climate variability. Therefore, this provided a basis to answer or attempt the last objective of the study. Table: 5.12 present responses among the selected respondents on the appropriateness of proposing CCEP in Sinazongwe District.

Table 5.12: Responses among respondents on the Appropriateness of Proposing a CCEP for Pastoral Farmers

Responses among respondents	Frequency	Percentages
Appropriate	66	94
Not Appropriate	0	0
Not Sure	4	6
Total	**70**	**100**

Source: (Field data, 2017).

Table: 5.12 shows that, majority of sixty-six (66) respondents ninety-four (94%) mentioned that it was appropriate to proposing a programme specifically for pastoral farmers in order to increase their adaptive capacity. This could facilitate pastoral farmers and local people to acquire necessary awareness, skills, knowledge, friendly practices and understanding on how to solve the problems being faced. In addition, no single respondents mentioned that the programme was not appropriate but only four (4) respondents six (6%) revealed that they were not sure of it appropriateness in order to address the effects of climate variability on pastoral farming in Sinazongwe District.

One of the leaders had this to say when asked to give his views on the appropriateness of CCEP to pastoral farming;

> *"Sir, the programme being proposing would be appropriate to pastoral farmers in order to increase the coping and adapt to effects of climate variability. Local people could acquire adequate information and knowledge on how to improve their livelihood and their adaptive capacity"* (Leader, 2017, Interview)

Yet one of the key pastoral farmers had the following to say when asked to give his views on the appropriateness of CCEP to pastoral farmers;

> *"Swebo bamalimi ba ngombe, tuyanda lwiyo (luzibo) ookono lubotu loko lwakuvuba Ingombe kutengwa lubono luvule kwinda mazuba aiinda. Eci chomwamba chibotu looko nkambo chilaleta lusumpuko. This could be translated as us pastoral farmers we want good education where we can learn*

how to rear our livestock as well as increasing our wealth in better way than previous in the area. What you are saying (proposing) to bring to us (pastoral farmers) could be good because it brings development". (Pastoral Farmer, 2017, Interview).

5.6.2 Educational Strategies to address Effects of Climate Variability on Pastoral Farming in Sinazongwe District

The respondents were asked to explain the appropriate educational strategies that could be used to provide knowledge and skills in order to increase the coping and adaptive capacity. Table: 5.13 shows that majority of thirty-three (33) respondents (48%) suggested Non Formal Education (NFE) as one of the appropriate educational strategies that could be utilised. This strategy involves conducting of seminars, local training programmes, workshops and lesson held outside the classroom environment with other facilitators. As indicated in Table 5.13, fifteen (15) respondents twenty-one (21%) mentioned that Formal Education (FE) could be appropriate and be utilised among pastoral farmers and other learners This encompasses teaching and learning of pupils and students in a classroom environment on pastoral farming. The results also indicated that three (3) respondents (4%) stated that extension services offered by agriculture officers could still be utilised to give the information patterning to disease on livestock and how to solve the problem. Lastly, one (1) respondents (1%) acknowledged the use of public and private media as an educational tool necessary to inform and educate pastoral farmers and local people on how to cope, adapt and address the effects of climate variability.

Table 5.13: Respondent's Responses on the Educational Strategies to address the effects of Climate Variability

Educational Strategies	Frequency	Percentages
Formal education	15	21
Non formal education	33	48
Informal education	7	10
Traditional education	3	4
Media	1	1
Community gatherings	8	12
Extension Services	3	4

Sources: (Field data, 2017).

Figure 5.6 shows the Learning Process (LM) on how CCEP can be used to address the effects of climate variability on pastoral faming in Sinazongwe District which can be a short or long term programme. Therefore, the long term process could be utilised for a longer period while the short term process could be for few years such as five years program meant to address a certain area depending to the availability of resources.

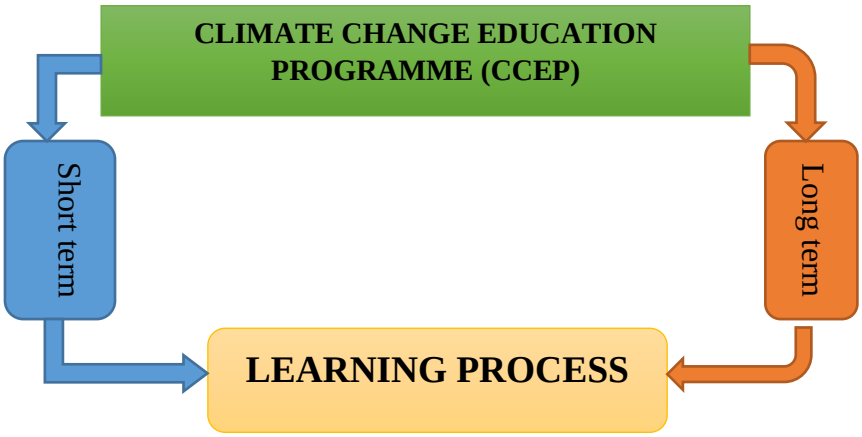

Figure 5.6: Learning Process of Climate Change Education Programme (CCEP) among Pastoral Farmers

Source: (Field data, 2017).

5.6.3 The Aim/ Goal of CCEP

The aim of the programme in Sinazongwe District is to address the effects of climate variability on pastoral farming through the provision of knowledge and skills to pastoral farmers and community members which could increase their adaptive capacity to the current and future challenges. In this regard, education is seen as an appropriate vehicle the can enhance and promote development in the pastoral farming sector thereby improving the livelihood of the local people.

5.6.4 Objective of CCEP

1. To educate pastoral farmers on climate variability knowledge
2. To equip pastoral farmers with good coping and adaptation strategies to effects of climate variability
3. To increase pastoral farming production at household level and large scale
4. To reduce the vulnerability to effect of climate variability among pastoral farmers

5.6.5 Principles of the CCEP

1. Holistic in approach
2. Multi-dimensional
3. Awareness
4. Participatory
5. Practical learning

5.6.6 Target groups for CCEP

1. Pastoral farmers
2. Local leaders
3. Youth
4. Pupils or Students
5. Local and international organisation
6. Government Ministries

5.6.7 Stakeholders involved in Facilitating the Implementation of a proposed CCEP

Table 5.14 indicate results obtained from respondents on the responsibility of stakeholders in facilitating the implementation of a proposed CCEP in Sinazongwe District.

Table 5.14: Responses from respondents on stakeholder's involvement in CCEP

Identified Stakeholders	Frequency	Percentages
Government	45	65
Organisation (CSOs)	17	24
leaders	3	4
Media	1	1
Community Members (Pastoral farmers)	4	6

Source: (Field data, 2016).

Table 5.14 shows that the majority of forty-five 45 respondents sixty-five (65%) indicated that the government is the major stakeholder in implementing the programme. Furthermore, eleven (17) respondents twenty-four (24%) mentioned of Organisations such as (CSOs, NGOs and FBOs) to participate and facilitate the implementation of the proposed CCEP, four (4) respondents six (6%) mentioned of community members (pastoral farmers) to be involved, three (3) respondents four (4%) indicated of local leaders and one (1) respondent (1%) mentioned of media to be involved in the implementation of the proposed program.

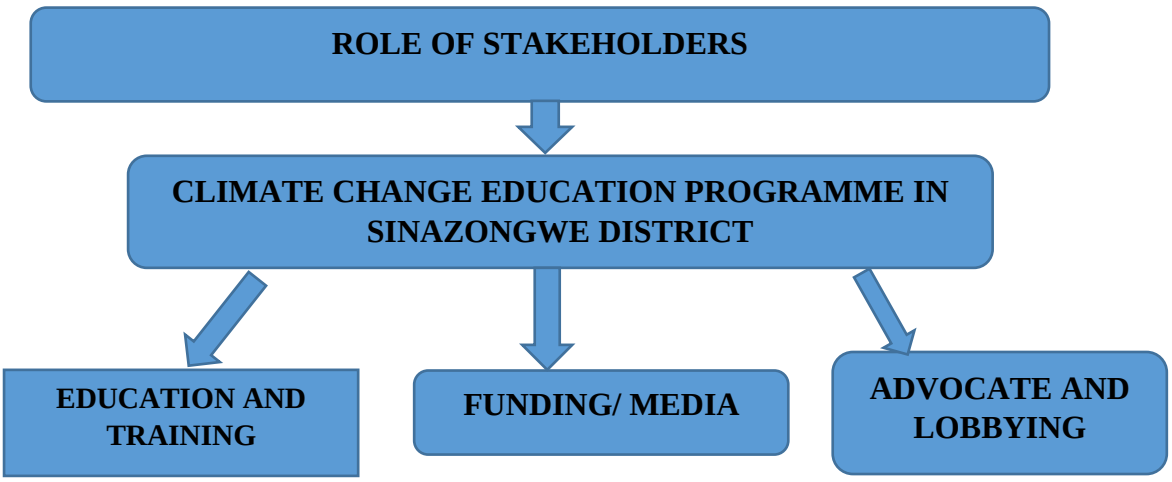

Figure: 5.7 Stakeholders involvement in addressing the effects Climate Variability on Pastoral Farmers in Sinazongwe District.

Source: (Field data, 2017).

As indicated in Figure 5.7 shows the roles of stakeholders in addressing the effects of climate variability on pastoral farming in Sinazongwe District. Respondents stated that, stakeholders should be involved in educating and training programmes such as conducting of meeting, seminars and workshops. They should also be engaged in the provision of loans and grants this could enable local people purchase adequate and correct vaccines for livestock. Lastly, stakeholders must be involved in the advocate and lobbying activities for pastoral farmers in order to increase their awareness, knowledge, skills and change of mind-set toward pastoral farming.

5.7 Chapter summary

The chapter summary presented the findings of the study by examining the perceptions toward the effects of climate variability on pastoral farming in Sinazongwe from 2001 to 2016, outlined the effects of climate variability on pastoral farming, examined the coping strategies to effects of climate variability among pastoral farmers and lastly provided findings on proposing a Climate Change Education Programme (CCEP) in order to increase pastoral farmer's adaptive capacity to the effects of climate variability.

CHAPTER SIX

DISCUSSION OF FINDINGS

6.1 Introduction

The previous chapter five presented the findings of the study according to the research objectives stated in chapter one. In this section, details of each objective and sub-themes was presented and generated. It also present the discussion of the findings on respondents' perception on the effects of climate variability on pastoral farming (2001-2016), the effects of climate variability on pastoral farming, coping strategies among to effects of climate variability on pastoral farming and proposing a climate change education programme to address the effects of climate variability on pastoral farming.

6.2 Demographic Characteristics

The study involved both male and female as selected participants. The majority participants were males as indicated (Table 5.1). The findings shows fifty seven (57) male eighty-one (81%) and thirteen (13) female nineteen (19%) that participated. The study also indicated that female respondents had information about the effects of climate variability on pastoral farming and how they cope and adapt to the challenges being faced on pastoral farming in the last fifteen years. It was appropriate to gather information from both gender were respondents provided depth views, understanding and experiences in relation to the study. Similarly to the results, Kebede and Adane (2011) also stated that gender was an appropriate variable were participants share diverse information and experiences on the problem affecting the community.

The study shows majority of the selected respondents who participated were literate or educate (Table 5.2). The findings shows that eighty-three (83%) of respondents attended primary education and above while 17% of respondents did not attend school. The overall levels of education was a significant variable that could affect decisions among pastoral farmers and other selected respondents on how to increase their adaptive capacity to the effects of climate variability. This is because education was more likely to expose farmers to any available information climate variability. Therefore, education play a vital role in enhancing the local pastoral farmer's ability to receive and comprehend information relevant to making innovative decisions about their livestock status such as time to vaccinate, animal mobility and disease control. Deressa and Hassan (2009), Yesuf *et al*. (2008) and Kebede and Adane (2011) also

reported that education increases the probability of adapting capacity to climate variability especially in prone countries such as Zambia, Zimbabwe, Botswana, Ethiopia and Somalia.

The results show that majority of participants are self-employed and others employed (Table 5.1). The study shows that forty (40) respondents fifty seven (57%) were self-employed and twenty-one (21) respondents thirty (30%) are employed by others people or institutions in the study area. It can be deduced that the source of income for local people or respondents was significant on how they cope and adapt to effects of climate variability on pastoral farming. A household that has income can manage to keep their livestock by buying needed vaccines to treat his animals. On the other hand, a household with low income could fail to buy appropriate vaccines or the needed items in order to cope and adapt to the challenge. Therefore, this can contribute to the loss of livestock.

The study also reported that the number of years stayed practicing pastoral farming can influence on the awareness of climate variability among respondents because of the experiences they could have faced. These demographic factors of respondents has influence on how they perceive situation through observed variability on rainfall, temperature and change of seasons in the last fifteen years (2001-2016). The findings concurs with a study conducted by Mertz *et al.,* (2009) showed farmers in Savanna Zone of Senegal were aware of climate change and variability. The study mentioned of identified intensive wind and occasional excess rainfall were the most destructive climatic factors. The study also figured out that households farmers noticed a decreasing trend in overall rainfall and increased temperatures throughout the year and that cold periods have become shorter and hot periods longer.

The majority of respondents had livestock from 20 to 100 above depending to their locality (Table 5.4). It was noticed that, most of the pastoral farmer in the Northern part of Sinazongwe District had little livestock due to increased challenges faced throughout the year. These includes lack of availability or access to clean water, prone to diseases and lack of pasture affecting the rearing of livestock. On the other hand, pastoral farmers in the Southern part had access to clean and availability of water and good pasture. The selected respondents also revealed that, loss of livestock was being experienced as a results of the effects of climate variability being experienced that has reduced livestock population and rearing of livestock in the area.

6.3 Perceptions of Pastoral Farmers on the effects of Climate Variability on Pastoral Farming:

The study indicated that local household pastoral farmers perceived the effects of climate variability on pastoral farming such as increase in temperature, increase in diseases and pest, drought, flush floods and erratic rainfall affecting the rearing of livestock as indicated (Table 5.7) and (Table 5.8). The findings are similar with a study conducted by Gandure *et al.,* (2012) also revealed that farmers in South Africa perceived increase in temperature and further indicated summer temperatures were warmer while winter temperatures were colder. The farmers also reported of decrease in rainfall or precipitation reducing pastoral productivity. A study conducted by Acquah de Graft (2011) in Ghana, indicated that 60% of the farmers reported that there has been a noticeable increase in temperature and 49% reported a decrease in rainfall as well as the study analysed the perceptions of climate change and variability in Western Ghana were the majority of farmers perceived an increase in temperature and decrease in precipitation that had adversely affecting the agriculture sector.

The study further revealed that pastoral farmers had observed changes through the decrease in the number of livestock. It also noticed that pastoral farmers had many livestock before than it was today, as a result of changing temperature, rainfall patterns, droughts, increase in diseases and heat stress being experience causing an increase in the loss of livestock. A study conducted by Mandleni and Anim (2011) similarly pointed out that about 86% livestock farmers in the Eastern Cape of South Africa were aware of the increase in temperature pattern and that weather conditions in the province was dominated by drought increasing the loss of livestock. In addition, a study by conducted by Akponikpè *et al.,* (2010) were samples from Benin, Burkina Faso, Ghana, Niger and Togo also reported of decrease in rainfall, change in rainfall pattern with delayed rains and early cessation and a significant increase in temperature characterized by an increase in the number of hot days.

The study also reported that majority of farmers noticed of temperature variability and irregular onset and duration of the rainy season were farmers depends on rain-fed for their agriculture. The finding shows that respondents were aware of the effects of climate variability on pastoral farming as evidenced noticed by more irregular rainfall patterns and increased temperatures being experienced. They also noticed extreme climate events such as drought occurrence or prolong dry spells within the cropping seasons and flush floods in some years. The findings are similar to the study conducted by Maddison (2006) a survey covering seven African countries

were a significant numbers of farmer also reported of being aware of the effects of climate variability, thus observed through the increased temperature and declined precipitation in the those countries. As study by Sofoluwe *et al.,* (2011) also mentioned that the majority (more than 75%) of farmers in Osun State of Nigeria perceived increase in temperature and decrease in precipitation pattern.

The results also showed that pastoral farmers with access to extension services that were being offered by local agriculture officers and leaders led them to perceived changes as a result of the effects of climate variability on pastoral farming. Furthermore, it was observed that local pastoral farmers were able to observe changes due to increase in the number or loss of livestock and wealth. Therefore, the findings concurs with a study conducted by Gbetibouo (2009) in South Africa which argued that farmers with access to extension services are more likely to perceive changes in the climate because extension services provide information about climate and weather. Further, households wealth represented by farm and non-farm income and livestock ownership increases the likelihood of climate change awareness (perception) (Yesuf *et al*., 2008).

In addition, the results showed that pastoral farmers experienced temperatures variability and drought in both the Southern and Northern Zones of Sinazongwe District. The study indicated that the area has become prone to drought occurrence as a result of erratic rainfall. An empirical studies by (Deressa *et al.,* (2008) revealed similar results on temperature variability and humidity in Ethiopia affecting the agriculture sector that includes crop and pastoral farming in the last three decades. According to Nhemachena and Hassan (2007) similarly, also examined farmers' adaptation strategies in South Africa, Zambia and Zimbabwe that reported most farmers perceived long-term increase in temperature and the region was getting drier with changes in the timing of the rains and frequency of droughts.

The results from respondents showed that they experienced changes in rainfall pattern yearly as a result of change in climatic season. Pastoral farmers mentioned of shortened rainy season than the way it was previously. It was reported that below normal rainfall and above average rainfall were common or noticed in all the Zones. The study also indicated change in timing of rainfall or onset rainfall, increase and decrease in temperature period and change in the availability of pasture. However, some pastoral farmers could not respond to some questions

due to lack of awareness, knowledge and poor literacy or education background. On the other hand, some respondents perceived effects of climate variability as punishment from God. A study in Ethiopia by Legesse *et al.,* (2013) also reported that pastoral farmers experienced changes in rainfall pattern, increasing temperature change, droughts, lack of water and perceived punishment from God as a result of effects of climate variability.

The perceptions among pastoral farmers on the effect of climate variability was not favourable to the local condition than it was before. Most of the respondents acknowledged experiencing the effect of climate variability (2001-2016) on pastoral farming. The level of education among respondents influenced their views toward explaining how they perceived the situation in the area. In this regard, the findings are agrees with the study conducted by Thornton *et al.,* (2007) revealed that effect of climate variability on pastoral farming had changed around the world especially in the developed countries were loss of livestock has continued to increase as experienced in Zambia, South Africa and Zimbabwe.

The study also revealed that pastoral farmers who are more educated were likely or able to interpret and apply climate information correctly. The results showed that the educated respondents were able to explain how they perceived climate variability on pastoral farming. These involved an increasing temperature, reduction in rainfall, onset rainfalls and shorten of the farming season. On the other hand, the uneducated people could not perceive the effects of climate variability on pastoral farming when asked due to lack of education and information available. In view of this, pastoral farmers had diverse perceptions on the effects of climate variability depending to how they have experienced. The study also revealed that those who had lost a lot of livestock and stayed in the area for many years had experienced the worst on the pastoral farming.

The study argues that perceptions of pastoral farmers on the effects of climate variability on pastoral farming was diverse depending to the loss of livestock. It was established that pastoral farming faced numerous challenges in the last five years as indicated by respondents such as an increase in the loss of livestock due to change in the climatic seasons. Most of the pastoral farmers interviewed mentioned that, those that haven't faced numerous challenges perceived the situation different or as normal different to those that have lost livestock almost every year. A prior studies in Zambia by Muchanga (2011) conducted on the perceptions of small scale farmers on the general aspect on the impact of climate change in Lusaka Province. The study

indicated that small scale farmers were affected from the impact of climate change and variability depending to their location which includes pastoral farmers.

6.4 Effects of Climate Variability on Pastoral Farming:

The study revealed that the effects of climate variability on pastoral farming in Sinazongwe District include rainfall variability, temperature variability, drought occurrences, prone to floods and increase in diseases and pest.

6.4.1 Rainfall Variability

The study showed that most of the pastoral farmers depend on the rain-fed to improve their agriculture production. The respondents mentioned that, the reductions in the rainfall patterns over the last two decades had caused setback thereby increasing the loss of livestock due to lack or shortage of water, poor pasture growth and increase of animal's diseases that comes as a result of lack of water (Table 5.9). According to Juana *et al.,* (2013) similar findings also indicated that Sub Saharan Africa was among the most vulnerable regions to climate change and variability were pastoral farming had experienced worst situations. Majority of pastoral farmers faced the challenges which was as a result of highly dependent on rain-fed agriculture for their economic activities to sustain their livelihood.

The study showed that Sinazongwe District lies in the Ecological Region I of Zambia receiving less or minimal rainfall annually of 700 mm as outlined (Figure 6.1). The results shows that the ecological region 1 had experienced effects of climate variability on pastoral farming in the last two decades were respondents mentioned the increase in the loss of livestock as a results of shortage of water, increased diseases and pest in the Great East Rift Valley and drought occurrences. It's noticed that the area had experienced short rainfall season increase in high temperature, humidity and change in wind situation. The findings are similar to Zambia Meteorological Department (2010) as well as IPCC (2007) reports indicated that changes in rainfall pattern and temperature would be observed and experienced in most Southern African countries were pastoral farming would be vulnerable to the effects of climate variability and change.

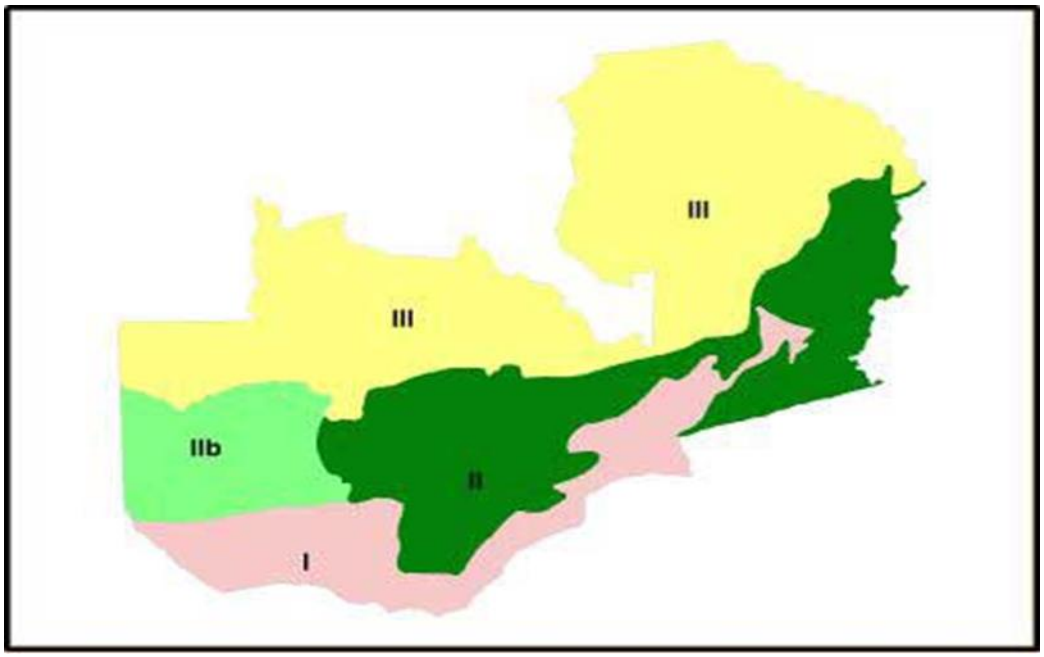

Figure: 6.1 Agro Ecological Zones of Zambia
Source: (ZVAC, 2007 and ZMD, 2010)

Figure 6.1 shows the Zambia Agro-Ecological Regions I, IIa, IIb and III. The Regional Annual Rainfall includes Region I receive less than 700, IIa receive about 800 - 1000 mm, IIb 800 - 1000 and III receive about 1000 – 1500.

The study also established that the study area had also experienced good or favourable rainfall patterns were pastoral farmers had little or no challenges on the availability or shortage of water. In the rainy season of 2008-2009, heavy rains in Zambezi Valley particularly in Sinazongwe were observed or experienced. This led to many local streams not dried up fast and livestock (animals) had access to water within the areas. The local pastoral farmers also experienced longer access to wet-season pasture. However, there are also significant negative consequences including loss of livestock through heat stress, loss of land to agricultural encroachment as the rise in rainfall raises the productive potential of arid areas, an increase in frequency of flooding, and the spread of human and livestock diseases that thrive during the wet season (Oxfam International, 2008).

The respondents mentioned that, one of the major effects of climate variability is the availability of water in the area. Pastoral farmers had experienced reduction in the availability of water in most of the Zones due to rainfall variability. The findings are similar to the study conducted by Thornton *et al.*, (2009) in Africa (Southern Africa and East Africa) were it was

established water availability issues could influence the livestock sector, which uses water for animal drinking, feed crops, and product processes. According to Nardone *et al.*, (2010) the livestock sector accounts for about 8% of global human water use and an increase in temperature may increase animal water consumption by a factor of two to three. In this regard, to address this issue, there was need to produce crops and raise animals in livestock systems that demand less water or in locations with water abundance.

6.4.2 Temperature Variability

The study examined the effects of climate variability on pastoral farming in Sinazongwe District such that, pastoral farmers had experienced an increase in temperature from all the Zones. During the interviews and FGDs, the participants had similar findings indicated that they had been experiencing temperature variability in the area which has contributed to growth of pasture in the areas, increase in heat stress among animals and poor animal health as a results of outbreak of new diseases and pest. This has led to increase in loss of livestock and rearing of livestock in the area. The findings are similar to the study conducted by Mwiturubani *et al.*, (2010) who stated that high temperature degrades the resources in the rangelands and cause starvation and death of livestock. The study also established that decimation of animals has severe consequences for livestock farmers as their survival depends predominantly on their livestock and this has led them to reducing rearing of livestock.

The study also showed that there was temperature variability, thus it was becoming hotter than in the previous years. The respondents provided examples from the year (2001-2004) and (2013-2015) having experienced high (increase in) levels of temperature especially in the months of July to November yearly. This showed a different from the previous experience where the area could experience high temperature in the months of September and to early November before the rainy season start. This notable change had greatly affected the growth of pastoral farming. Today, pastoral farmers preferred to keep goat, pigs and sheep than cattle because they can survive and adapt in a long dry spell or. The findings agrees with the study conducted by Nhemachena and Hassan (2007) which reviewed changes in temperature in Southern Africa that includes Zambia being affected by climate variability on the agriculture sector in the region (inclusively pastoral farming).

In addition, one of the pastoral farmers during the interview said that, when it's very hot cattle fails to move long distances to search for food and water in the area such as covering more than

10-20 kilometres in search of water every day. Therefore, the experience of high temperature in the area requires cattle to drink a lot of water for it to survive and avoid other health complication such as suffering of viral diseases which have become common. In this regard, pastoral farmers preferred the rearing of goats, chicken and poultry than having cattle because the challenges and responsibilities being faced. Hence, most of pastoral farmers tend to sell cattle and remain with few which they can manage to keep in the area.

The findings among respondents' showed that temperature has increased to 39 - 42 degrees Celsius according to the recorded obtained from the Department of Agriculture in Sinazongwe District. These changes had been experienced mostly in the dry season area affecting the livestock production than in the wet season. In this regard, the findings are similar to the reports conducted by the Intergovernmental Panel for Climate Change IPCC (2007) indicated increase in global average temperature above the range of 1.5 -25 degrees Celsius which would be experienced around the world especially in poor developing countries. However, there is no respondents explained that there was no change experienced as a result of the effects of climate variability on pastoral farming.

The study shows that pastoral farmers noticed temperature increase as recorded from the three meteorological station that exist in the study area. The three stations are found in Maamba Zone, Mweemba Zone and Sinazongwe Zone. The 32 meteorological stations in Zambia were analysed to detect trends in temperature change over last 30 years. The mean temperatures computed for the Agro-Ecological Zones for three time periods, November–December, January–February and March–April, indicate that the summer temperature in Zambia had increasing at the rate of about 0.6° C per decade, which is ten times higher than the global or Southern African rate of increase of temperature. The rate of increase is highest in November–December as compared to other periods across all agro-ecological zones (Hulme, 1996). The study provide similar results that temperature has continued to increase in Sinazongwe district of Southern Province affected the agriculture sector particularly pastoral farming.

6.4.3 Drought Prevalence

The study examined that drought prevalence or occurrence had contributed to the poor pastoral farming in the last two decades. Findings during the two FDGs conducted and interviews showed that extreme weather events that had occurred from 2001-2009 such as experienced little rainfall, temperature increase and change in on-set rainfall. There had been an increase in

the soil erosion affected the growth of pasture for livestock especially in Mweemba and Sinazeze Zones. It was noticed that from 2003-2005, pastoral farmers had experienced loss of livestock as a result of shortage of water, increase in poor pasture, outbreak of diseases and increase in heat stress. The findings are similar to the study by Abate (2009) that drought and delay in the onset of rains led to poor regeneration of grass, water shortage, and heat stress on livestock. It was also reported that there was an increase mortality of livestock, vulnerability to diseases and physical deterioration due to long distances travel for water and pasture in the dry season in Africa.

The findings showed that pastoral farmers had experienced increase in drought increasing the loss of livestock in the area. It was mentioned that, the effects of drought in the area had reduced the practicing of pastoral farming. Respondents stated the increases of animal diseases and pest, increase in the shortage of water, quality of water and loss of pasture and food for animals in the area increase in heat and temperature. Therefore, similar findings by Digambar (2011) also reported severe drought, there was a direct impact on the growth of palatable grass species and the regeneration of fodder species in pasture and forest fodder is decreasing because of less rainfall leading to a shortage in diversity and quality of livestock fodders.

6.4.4 Increase in Diseases and Pest

The study indicate that pastoral farmers and local leaders had similar information collected from focus group discussion and interviews. It was noticed that, unstable temperature change was causing an increase in animal diseases and pest. The study determined that animal diseases and pest have become more favourable thus increasing the loss of livestock. For instance, the outbreak of lumps skin and foot and mouth diseases (2014-2016) led to increase in the loss of livestock both in the Southern and Northern part of the District. The findings show that livestock no longer walk long distances to search for pasture (food) and water due to poor health and eventually dies. The results were observed and obtained among pastoral farmers from all zones in Sinazongwe District indicating serious outbreak of diseases in the area. The findings concurs with earlier studies by Muchanga (2013) in Luangwa - Zambia and Digambar (2011) in Swaziland were it was in both cases reported that, increase in temperature had caused the outbreak of new born diseases and scarcity of fodder leading to change in livestock pattern. The study by Digambar (2011) further indicated that many Southern African country would be affected due to hush climatic variability condition being experienced in Sub Sahara Africa than in developed countries.

The results showed that the effects of temperature variability on pastoral farming had increased the burden of disease in the last two decades. The study indicated that pastoral farmers had faced harsh diseases in the warmer period (dry season). It was noted that due to increase in temperature and lack of water, most of the livestock been losing weight and eventually dies. In this regard, the finding on the effects concurs with prior studies by Harvell *et al.,* (2002); Karl *et al.,* (2009); Patz *et al.,* (2000) were temperature increase had accelerated the growth of pathogens or parasites that could live part of their life cycle outside of their host, which have negatively affects livestock. According to Thornton *et al.,* (2009) stated that diseases transmission between hosts would be more likely to happen in warmer conditions and effects could be noticed on the agriculture sector. In addition to the findings, White *et al.* (2003) also simulated the effect of climate change and variability on Australian livestock in which livestock lost about 18% of their weight due to increased tick infestations. Livestock farmers also reported that the climate change and climate variability have led to decreased livestock weight and an increase in livestock death. These imply loss of farm income and livelihood for the majority of the rural population (Mengistu, 2009; Sofoluwe *et al*., 2011; Mandleni & Amin, 2011; Mertz *et al.,* 2009).

6.4.5 Heat Stress

The study indicated that, heat stress was one of the effects of climate variability on pastoral farming due to increase in temperature and rainfalls variability being experienced. It was noticed that pastoral farmers in the Northern Zones of Sinazongwe District experienced adverse challenges leading to the increase in the loss of livestock than those in the Southern Zones located near the Lake Kariba. This was due to poor access to water, increase in temperature, dried streams, lack of boreholes and poor pasture. The finding agrees with the study conducted by Thornton *et al.,* (2009) and IPCC (2007) reported that heat stress on livestock was dependent on temperature, humidity, species, genetic potential, life stage, and nutritional status. The study also indicated that livestock in higher latitudes could be more affected by the increase of temperatures than livestock located in lower latitudes, because livestock in lower latitudes are usually cope and adapt to high temperatures and droughts occurrences.

6.5 Coping Strategies among Pastoral Farmers:

Some of the existing coping strategies being practiced by pastoral farmers which were examined includes veterinary services, pasture growth, crossbreeding and restocking, traditional medicine, selling of animal, animal mobility and control, feed stock, water harvesting, sinking of boreholes and well, engaging in other economic activities, early warning system, sharing among relatives and herd management. These are strategies that were obtained from the selected participants.

6.5.1 Veterinary Services

The study established that BQ vaccinations occurs every after six months in the area. This is due to lack of medicine, few veterinary officers and inadequate financial support among pastoral farmers. During the FGD and Interviews among respondents lamented that lack of financial and access to loan has had contributed to poor livestock management and practicing of friendly sustainable coping strategies. Hence, some pastoral farmers still use traditional medicine in treating their animals as a result of the increase diseases and pest. The study revealed that, it was commonly and cheap being practiced to treat animals since there was poor veterinary services and lack of finances to buy animal vaccines.

The study indicated that Sinazongwe District has only two dip tank which are currently not working or dilapidated causing a serious burden to pastoral farmers. The dip tank are located in Sinazeze and the Buleya Malima Zone which pastoral farmers were utilising. However, when in operation, the fees or charges per animals were too high for pastoral farmers to pay since they had a lot of livestock. Furthermore, the cost of transport to the dip tanks hindered or was a challenge for local pastoral farmers. It was mentioned that, most of the available dip tank are not working which has led to poor treatment and management of livestock. This has contributed to the increase in the loss of livestock. Therefore, there is need for construction of modern dip tank for pastoral farmers to enable them treat their livestock from diverse diseases and pest.

6.5.2 Pasture Growth

Poor pasture growth was as a result of erratic rainfall pattern or drought and increasing temperature being experienced in most part of Sinazongwe District. It was observed that pastoral farmers were utilising the availability of good pastures near the banks of the local

streams and mountain. Some farmers feed their livestock with crop left-over from maize, millet and sorghum in dry season from May to October. According to Mubaya (2015) the study also reported that during drought times, pastoral farmers tend to monitor the growth of pasture as a way of preserving it. It was discovered that other areas were restricted to avoid over-crowding especially in the bank of a stream or river. The study also stated that pastoral farmers engage in growing crops that can withstand in drought season and use the leaves to feed their livestock.

6.5.3 Animal Mobility

Animal (livestock) mobility is one of the coping strategy used to cope and adapt to the effects of climate variability on pastoral farming. It was mentioned that, despite having a free range grazing, livestock were restricted in perceived locations that are affected with diseases and pest and tend to take animals in safer areas for grazing. It was noticed that guidelines and instruction are given by veterinary services and agriculture officers on how to avoid animals or livestock not to be affected with diseases. The distance and frequency of pastoral mobility depends on spatial and temporal variations in resource availability. Moreover, long distance movements by livestock was mainly caused by scarcity of rangeland resources triggered by severe droughts and range degradation. Similarly to the findings, Digambar (2011) also reported that pastoral farmers in Southern African and East Africa tend to restrict their animal or livestock mobility as a way of controlling their animals from diseases and pests.

6.5.4 Animal Feeding Stocks

The study examined that pastoral farmers in Sinazongwe District feed their animals using maize, sorghum and millet crops. This usually happens after harvest has taken in the period of May to August every year. It was mentioned during the interview that pastoral farmers keep feeding stocks for animals when they would experience poor pasture growth in the dry season. Further, the study discovered that, in times of drought many local farmers keep grass in order to be used in the future months as a way to improve and enhance the survival of livestock. Therefore, there are similar findings from Augula, (2010) conducted a study among farmers in Namibia found that to improve the chances of livestock survival, and they engaged in collecting pods from acacia trees for feeding. The findings agrees with study which was conducted by Ziervogel (2004) in Lesotho, that local farmers cultivate lucerne and teff as fodder crops for livestock in order to survive harsh climatic conditions.

In addition, some respondents mentioned that in the dry season the area experienced poor grass growing in especially in the Northern region of the district which consists of Maamba, Sinazeze and part of Buleya Malima Zones were as a result of lack of rainfall. Further, the local leaders in the community provided restrictions on the grazing land for livestock area perceived that are prone to outbreak of diseases and pest. In this regard, some few small scale and commercial pastoral farmers had resorted to purchase hay at ZAMBEEF ranch situated in Sinazongwe (Bushi area) and Kachindu Ranch in order to feed their livestock. Therefore, they is need to increase the selling of fodders in the area due to the increase of drought and shortened rain season since most of pastoral farmers depend on the natural grass and rain-fed to improve the livestock production

6.5.5 Crossbreeding and Restocking Strategy

The findings showed that respondents had adopted drought-tolerant livestock species such as goat, donkey, chicken, pigs and sheep than cattle it was before. The study examined that, more pastoral farmers had changed from rearing cattle to drought tolerant livestock in the last fifteen years due to the increased loss as well as being expensive to manage cattle livestock because of climate variability. Pastoral farmers are engaged in the restocking of animals and reduced the size of livestock at household level. It was noticed that due to access to information among pastoral farmers, restocking of animals was a way of replacing the loss of livestock and increases in crossbreeding with breed that could adapt to changing climate conditions. The findings concur with the study conducted by Nzeadibe *et al.*, (2011) and Mandleni & Anim, (2011) reported that livestock farmers in Sub Sahara Africa has switched to livestock that can withstand water stress and hot temperatures. Restocking of livestock should be within the limit to avoid over cropping and grazing of pasture. The findings are similarly to Mubaya (2015) agrees that pastoral farmers has adopted several different coping strategies to increase their adaptive capacity such as reducing the size of cattle at house hold level, cross breeding mechanism to breed that can cope despite the continuous increasing heat and change of temperature and water availability.

6.5.6 Climate Variability Information

The results showed that pastoral farmers had no access to information on meteorological data which could provide clear warning and time to apply coping strategies to increase their adaptive capacity. The study revealed that rainfall patterns or variability were changing every year thus affecting the growth of pastoral farming. This has led pastoral farmers not to predict future

patterns in order to improve the rearing of livestock. The findings agree with the study conducted by Hulme *et al.,* (2001) mentioned that rainfall variability was high in Africa which is increasing the vulnerability among pastoral farmers such as poor land for pastures and reduced water storage.

It is noted that pastoral farmers are not provided with clear information patterning the change of weather conditions thereby influencing the use of poor strategies to adapt to effects of climate variability. In addition, the effect of climate variability between years and over decade-long periods combined are generally poor meteorological data across the continent, makes it a challenging to observe and predict future patterns among farmers. The study also established that there were no early warning system to pastoral farmers. Therefore, the government and stakeholders should provide necessary information to pastoral farmers in order to increase their adaptive capacity.

6.5.7 Water Harvest System

The study established that there was need to increase the water harvest system in order to reduce depending on rain-fed water. In his earlier study in Monze, which is part of Southern Zambia, Muchanga (2017) recommended the need to construct more dams to increase water storage and sustain livestock in dry season. Nevertheless, this may also not be sustainable enough if sedimentation is not properly monitored (Muchanga, 2017). It is noted that, the loss of livestock was attributed mainly as a results of shortage and poor quality of water. This was also observed by Muchanga (2017) however his experimental study also noted that not all chemical parameter were harmful to animals or livestock. In addition, sinking of boreholes could also increase the availability of water thereby reducing animal stress of walking long distances in search of water. The study argues that there is need to increase the water harvest system in the area to reduce the shortage of water especially when faced with prevalence of drought. This similar to the findings by Mandleni & Anim (2011); Deressa *et al.,* (*2*008); Mertz *et al.,* (2009); Gandure *et al.,* (2012) which reported that for pastoral farmers to cope with or adapt to climate change and variability in Sub-Sahara Africa, they have dug more boreholes in drier regions, construction of dam, switched to off-farm income generating activities and have reduced the number of livestock and by slaughtering and/or selling them during extended drought periods.

6.6 Proposing a CCEP to address Effects of Climate variability (CV) on Pastoral Farming in Sinazongwe District:

6.6.1 Appropriate of CCEP to Pastoral Farmers

The study established that pastoral farmers are aware of the effect of climate variability on pastoral farming. This was as a result of extension services being offered by agriculture and veterinary officers. The results indicated that majority of respondents acknowledged the appropriateness of proposing a programmes for pastoral farmers in Sinazongwe District. In this regard, it could improve pastoral farmer's knowledge which could hasten local coping and adaptation strategies among pastoral farmers. Therefore, the provision of extension advice may also play a role in promoting and increasing adaptive capacity to the effects of climate variability.

6.6.2 Educational Strategies

It's known that, experienced pastoral farmers usually had better knowledge and information on the effects climate variability and sustainable practices that can be used to cope and adapt to changing climate. The study suggests that education strategies could improve their awareness of the potential benefits from adaptation which could be an important policy measure for stimulating farm-level climate adaptation. In this regard, prior studies in Kenya, Ghana and Zimbabwe also indicated the significant benefits that accrue from local climate information (weather updates) which could increase the awareness of climate change and variability in terms of more informed coping and adaptive decisions and improved technology uptake among pastoral farmers (Kalungu *et al.*, 2013 and Mapfumo *et al*., 2013).

6.6.3. Non Formal Education

The study established that Non Formal Education (NFE) could be the best educational strategy to address the effects of climate variability. It was noted that, local pastoral farmers could gain appropriate knowledge through participating in organised meeting, seminars, workshop and community learning to increase their adaptive capacity. NFE involves learning that take place outside the normal classroom environment were all targeted group and learners such as pastoral farmers, headmen, chiefs, community leaders, councillors, government and others can be taught and acquire innovative skills on how to address the current problems. Article 6 of the UNFCCC (2007) directs both developed and developing countries to consider education, training and public awareness as an integral or fundamental response to climate change and

variability. Increasingly, country must plan, propose, developed and utilize the UNFCCC framework by incorporate education-specific elements.

6.6.4 Formal Education

Formal education as one of the educational strategies that can be adopted or utilised to bring about awareness and increased adaptive capacity. The results show that climate variability knowledge should be integrated into the formal education sector were learners and the local people could gain relevant skills, knowledge and understanding on how to cope, adapt and apply sustainable measures to improve pastoral farming. In relation to the Ahmadabad International Convention on Environmental Education held in India, it provided guidelines on how environmental challenges could be addressed around the globe which includes improving the provision of formal education to all learners (inclusively pastoral farmers) as a way of improving the livelihood of the people thereby reducing climatic vulnerability.

The study also established that formal education on pastoral farming among the local people could enhance and improve livestock production. Climate Change Education Programme should be integrated from primary to higher learning institutions since the country depend on agriculture sector. The findings are similar to Muchanga (2013) which proposed a learning model for rural and urban community to address the impact of climate change in Lusaka Province. The study provided emphasis on local leaners acquiring climate knowledge in order to boast local adaptive capacity. Shumba (2010) also indicated that formal education as an educational strategy could play a major cardinal role in bring address the effect of climate variability on pastoral farming were local people could gain skill and knowledge to improve their livelihood.

6.6.5 Informal Education

The study noticed that pastoral farmers had inadequate information or knowledge on the coping and adaptation strategies due to lack of extension services being provided. The results also indicated that pastoral farmers were vulnerable to the effect of climate variability in the last fifteen years (2001-2016) due to inadequate extension services, lack of financial and institutional support. Informal education could be used to provide climate variability information, coping and adaptive strategies and enhance community participation and learning among pastoral farmers. The findings concurs with Nzeadibe *et al.,* (2011) reported that

pastoral farmers fails to apply good existing coping strategies and adaptation to climate change and variability was due to lack of information asymmetry, irregularities of extension services, poor government attention to climate problem, low institutional capacity, lack of knowledge on adaptation measures and un sustainable use of traditional knowledge.

The study also argues that non-existence (lack) of a deliberate educational strategy to increase pastoral farmer's knowledge on how to cope and adapt to the effects of climate variability has led to increase in the loss of livestock. The study revealed that a deliberate educational programme among pastoral farmers could enhance the coping and adaptive capacity. This could increase the livestock production as well as increasing sustainable practices. The existing designed learning model for pastoral farmers was too general and not specific to pastoral farming. Therefore, the proposed CCEP would be appropriate to pastoral farmers both in rural and urban areas to increase the adaptive capacity to environmental problem.

The study also established that, pastoral farmers need to form co-operative in order form them to receive assistance from the government and other stakeholders. This could foster adequate and necessary meeting among members on how to improve their livelihood. The Zambian National Agriculture Investment Plan (2014-2018) provided a roadmap on how to improve livestock production despite overwhelming evidence on the effects of climate change and variability affecting pastoral farmers. It was also noted that, crop farmers were the majority beneficially to the extension services being offered by local agricultural officers than pastoralist. Therefore, the performance of extension services are below per than the expected outcome.

6.7 Climate Change Education Programme for Sinazongwe District

Climate Change Education Programme for pastoral farmers of Sinazongwe District would increase the awareness, understanding and knowledge on how to cope, adapt and enhance sustainable pastoral farming. This programme could also increase the learning process, use of appropriate practices, enhance stakeholder participation and increase the coping and adaptive capacity among pastoral farmers to the effects of climate variability. Furthermore, the CCEP programme could be implemented in the long or short term basis depending to the situation and availability of resources to address the problem. In addition, formal, non-formal and informal education approaches could be used to educate pastoral farmers and local people on how to improve pastoral farming despite the increasing effects of climate variability in

Sinazongwe affecting the rearing of livestock. The summary of Climate Change Education Programme as indicated in Figure 6.2.

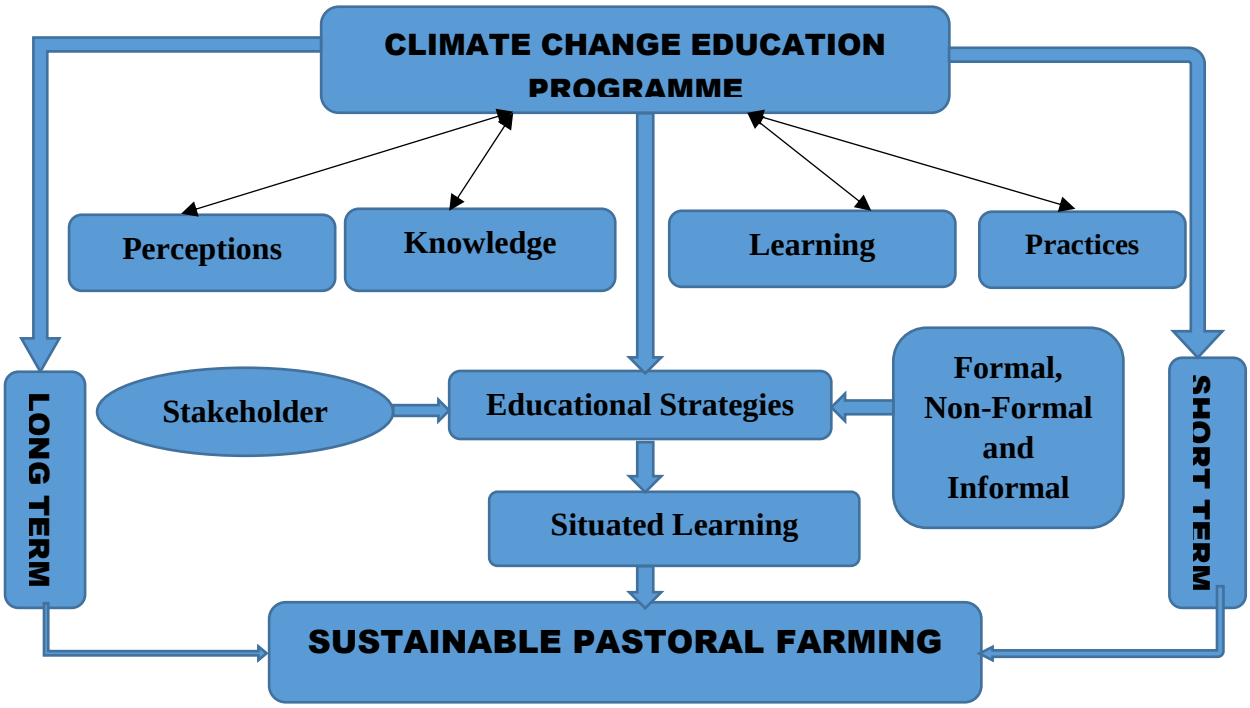

Figure 6.2: Climate Change Education Programme for Sinazongwe District

Source: (Adapted from Muchanga, 2012).

6.8 Learning Programme for Pastoral Farmers in Sinazongwe District

The proposed learning programme for Pastoral Farmers in Sinazongwe District is meant to address the effects of climate variability by providing necessary skills and knowledge on relevant the topics, learning contents, appropriate teaching methods that could be used by educator, trainers, actors involved in delivering of information, estimated budget, target group and monitoring and evaluated as indicated (Table 6.1).

Table: 6.1 Proposed CCEP for Pastoral Farmers in Sinazongwe District to address effects of Climate Variability

Topic	Content	Learning and Teaching Methods	Actors	Target Group	Budget	Monitoring and Evaluating
Introduction to Pastoral Farming	Definitions of pastoral farming	Focus Group Discussion, Community Meeting	Ministry of Livestock, Extension workers	Local Farmers, learners, journalist, civil servants	Estimated cost of K20,000	Comprehensive Formative and Summative

	Understanding of Pastoral Farming	and Observation	and Educators	and Local leaders		during the lesson.
Effects of Climate Variability	Diseases outbreak, Lack of Water, Poor Pasture Growth, Temperature and rainfall variability	Lecture, debate, Focus group discussion, classroom set-up, field work	Educators, Agriculture officers, Veterinary officers and Local leaders	Local farmers, Learners, Local Leaders, mining, institutions and NGOs	Estimated cost of K50, 000	Presentation of lessons, sharing of experiences, giving talks and interviews, report writing and test.
Coping/ Adaptation and Mitigation Strategies	Selling of livestock, vaccinations, dip tank, pasture control, animal mobility control, cross breeding, and herd management, restocking, ranching, dam construction, sinking of borehole planting of tree and diversification	Field trip, interviews, role play, lectures, FGD and community meeting	Councillors and Headmen, Ministry of Livestock.	Local farmers, Veterinary and agriculture officers, Local leaders	Estimated cost of K100,000	Community inspection, surveillance, participatory and report writing in both summative and formative
Policy Formulating	Participating of local people in constituency meeting, NGOs involvements and designing a policy	FGD, interviews, debates and meetings, seminars, workshops	Member of Parliament, Councillors , Civil servants, Learners and NGOs, CSO and Corporate	Local people, Councillors, headmen, Member of Parliament, Learners, Media personnel	Estimated K30, 000	Comprehensiv e summative and formative.
Training and education Programme	Adaptation and mitigation measures, benefits of pastoral farming, community mobilisation, knowledge and skills empowerment, community education, Social welfare	Classroom and non-classroom learning, FGD, interviews, debates, field trips, seminars and workshop	Councillors and Headmen, Corporate responsibili ty, Ministry of Livestock and Agriculture and CSO	Local farmers, Veterinary and agriculture officers, Local leaders	Estimated cost of K200,000	Comprehensiv e Summative and formative, checking of activities in the community through observation

	and training of officers					
Financial capacity	Provide Loans and grants to pastoral farmers	Focus Group Discussion, role playing and interviews, seminars, workshop	Banking Institutions, Ministry of Finance, Ministry of Livestock and Agriculture	Local farmers, Local leaders and Learners (women and youth)	Estimated cost of K20,000	Holistic approach in the Implementation of the project, summative and formative
Awareness and Sensitization	Media programmes, publishing of books, brochures, posters, banners, public speaking in schools and community meeting	Debate, media programmes, role playing, field trip and interviews.	Councillors and Headmen, Corporate responsibility, Ministry of Livestock	Household Local farmers, Local leaders, NGOS, CSO and Institutions	Estimated cost of K20,000	Comprehensive Summative and formative,
Monitoring and Evaluation	Inspection, auditing, reporting, media programmes and implementation of projects	Checking of project, debates, FGD and Interviews	NGOs, CSO, Ministry of Livestock and Agriculture	NGOs, CSO, Ministry of Livestock and Agriculture	Estimated cost of K30,000	Comprehensive Summative and formative,

Source: (Field Data, 2017).

6.9 Role of Stakeholders in addressing effects of Climate Variability on Pastoral Farming

The collective roles of stakeholders in address effects of climate variability on pastoral farming are needed in the area. The study suggested that stakeholders must be engaged in providing learning programmes to educate the local people which includes pastoral farmers. The mentioned stakeholders such as the Government, Non-Governmental Organisation, Pastoral Farmers or Local people and Leaders. This is similar to a study conducted by Muchanga (2012) which observed that, planning for climate change and variability would require a diversity of views from multiple stakeholders such as educationists, traditional leaders, the government, affected people, government statutory bodies, clergies, Non-Governmental Organizations (NGOs) and among others in order to address the problem.

6.9.1 Roles of the Government

The study shows that most of the pastoral farmers do not have enough income to improve their pastoral farming. It was stated that most of the local pastoral farmers do not have finance to buy medicine or chemicals in order for them to treat their livestock from diseases. The study established that the role of the government was to create an enabling environment and cooperate with other stakeholders in provide loans and grants to pastoral farmers. There is need to facilitate the introduction of pastoral farmer's cooperative to increase access to information and other services. The study also outlined that vaccines for livestock should be provided on time to curb emerging animal diseases among pastoral farmers. The above findings concurs with Namafe and Muchanga (2017) a study provided guidelines and significant roles for stakeholder in addressing effects of climate change and variability presently and in the future generation in Zambia. These stakeholders must be involved in mainstreaming of climate change and variability programmes to address social challenges in society.

It is noted that the effects of climate variability has impacted the livelihood of the local people were poverty levels and vulnerability to effects of climate variability has been experienced. The government should increase the learning and participation of local people in decision making. Therefore, the government is responsible to create an enabling learning environment were climatic information should be easily accessed and communicated. In addition, the government must provide early warning system equipment in order to have access to correct information and awareness programme should be improved in the local area. The findings are similar to MTENRs (2007) which also explicitly noted that lack of public awareness and education on climate change and variability, it effects could deter people from taking active role in coping and adaptation process.

Additionally, the government is to integrate the effects of climate change and variability into the school formal curriculum. The learners in schools and students in higher learning institutions must be taught and trained to understand about the effects of climate variability on pastoral farming and how to address the effects locally. In addition, the government through the Ministry of Education should also integrate pastoral farming in the education system since the agriculture sector is the major economic activity that can end poverty and create employments for the people. In view of the above, the government must facilitate the production of learning materials for learners as well as training of educators through

responsible institution such as Universities and Colleges. The Curriculum Developing Centre (CDC) in Zambia should help in developing appropriate learning materials for farmers and other learners in order to enhance climate change education and information.

6.9.2 Roles of Organisations and International Community.

The roles of Organisation (CSO) and international community is to provide extension and advisory services for both public and private institution. Today, pastoral farmers need information to quickly respond and adapt to climate change and variability. Local organisation should provide necessary educational strategies (climate variability intervention) to pastoral farmers to increase their adaptive capacity. Further, they should organise and integrate non-formal and adult educational programmes to increase awareness and understanding. This could be conducted such as local community meeting, seminar, door to door campaign and workshops with farmers in providing information and awareness on how to cope with the climatic conditions.

The CSO could also help in financial support programme in order to implement activities and projects. This could be implemented through providing of loans and grant to farmers. In this regard, farmers could enable them buy right medicines or vaccines to treat their animals and crops even when there is an outbreak of diseases and pest. The study mentioned that, pastoral farmers lack access to information, education, financial support and extensional services which has increased the loss of livestock. In view of this, CSO must take priority to increase their support in the provision of education to the local people especially pastoral farmers. The findings are similar to Acquah de Graft, (2011); Sofoluwe *et al., (*2011); Deressa *et al.,* (2008) and Nhemachena and Hassan, (2007) also indicated insufficient access to inputs, lack of knowledge, no access to water, lack of credit, lack of information, high cost of adaptation and insecure property rights is experienced among pastoral farmers.

6.9.3 Roles of Local Leaders

The local leaders has a bigger role to play in CCEP in the community. This includes chiefs, headmen, community leader's representatives, senior citizens and political leaders such as councillors and Member of Parliament (MP). The study revealed that, the responsibilities of the local leaders was to organise the people in community to work and be involved in the learning programme, facilitate the learning process, provide suitable information and ideas on

how to implement the programme and participate in decision making and formulate local policies.

6.9.4 Role of the Community Members

- Engage in active participation and learning process to cope and adapt to the effects of climate variability.
- Facilitate learning environment through organising and collaborating with the other stakeholders.
- Implementation of learned activities to improve the adaptive capacity to effect of climate variability.

Table: 6.2 Roles of Stakeholders in Addressing the Effects of Climate Variability on Pastoral Farming

Identified Stakeholders		**Roles and Responsibilities**	**Target Group**
Government	ZEMA	• Planning, conduct Environmental Impact Assessment, Public Participation and Funding	Pastoral Farmers, Local leaders, Educators, Trainers, NGOs and CSOs
	DMMU	• Disaster and Risk Management, funding, Monitoring and Control	
	Agriculture	• Training, Human resource, funding, research and community participation and policy formulating and monitoring	
	Livestock	• Vaccination programme, training, human resources, Funding, Participation, Conduct Local Meeting, Planning, Policy formulating	
	Education	• Integration pastoral farming into the curriculum, Training, Funding and Building of schools or training centres and empowerments	

Non-Governmental Organisation	• Funding, Implementing of projects, Research, Training, Advocacy and lobbying.	Local pastoral farmers
Local Leaders and community	• Participation, Community mobilisation and Training	All stakeholders
Media and Journalist	• Public awareness, training, media reporting	All stakeholders
Institution (Universities)	• Training, Policy formulating, Research, Monitoring and Public participation	All stakeholders

Source: (Field data, 2017).

6.10 Relevancy of the Proposed Climate Change Education Programme CCEP in the Agriculture Sector

- Provision of adequate and readily available climate information in the country.
- Increase participation among pastoral farmers, local leaders, Civil Society Organisation (CSOs) and government in addressing the problem.
- Increase knowledge, awareness, change of mind-set and behaviour aspect
- Increase climate change and variability research programme among researcher and policy makers.
- Increase agriculture production and local Agriculture Infrastructure development
- Fostering in ending hunger and poverty in communities
- Enhance and contribute in achieving Sustainable Development Goal in the country.
- Increase the need for financial support from government and other stakeholders.
- Increase collaboration and engagement among stakeholders.
- Promoting the designing of climate change and variability policies and frameworks.
- Increase the coping and adaptation skills and strategies among local people.

6.11 Theoretical Underpinning

Situated Learning is a learning paradigm based on a perspective of having learning in a contextual environment or the applied domain of the knowledge being acquired particularly

more important in industrial sectors where practical skills are of vital importance. The theory of situated learning was developed by Jean Lave and Etienne Wenger (1991) believed that learners were likely to learn more by active participating in their learning domain as opposed to listening to lecturers or teachers in a classrooms situation or environment. Situated learning is a mechanism that can be used to create meaningful from the real life activities where learning occurs. In this study, the findings agrees that educational strategies could play a fundamental role to bridge the existing gap of knowledge among the pastoral farmers in coping and adaptation to the effects of climate variability.

This model of learning as a part of Lave and Wenger's theory of communities of practice, which also states that learning should not be merely viewed as transmission of knowledge but as an embedded and active process among all learners and stakeholders. Therefore, the theoretical underpinning of the study was established that it could involve active learning being stimulated among pastoral farmers and local thereby enhancing their local existing coping and adaptive capacity. Henceforth, a proposed CCEP for pastoral farmers in Sinazongwe District could be a turn point and significance strategic instrument to increase their knowledge capacity and practical skills to address the problem as the theory emphasises to address the challenges that exist in the our societies.

The Situated Learning (SL) theory advanced with a purpose of providing a clear understanding and making sound decision with a goal contributing to the national development. The theory advanced in which local pastoral farmers would be involved in educating and helping the public to address many social issues existing in the contextual environment. This proposed programme can empower learners to engage in a more informed discourse which in turn can led to a better decision making and enhance the achieving of United National Sustainable Development Goal such as Sustainable Development Goal number 13 which focus on taking Climate Action by 2030. All countries across the globe are tasked to propose, develop and plan strategies to address facet of environmental problems starting from local to international level.

Situated Learning (SL) theory underpin the findings of the study that knowledge could be created through the interaction, sharing of experiences and observations among pastoral farmers and the researcher. The theory also agree with the findings that there is need for involvements of various stakeholders in the learning process in order to address the problem. Pastoral farmers suggested involvement of the Ministry of Education, Agriculture, Civil

Society Organisation and other partners in promoting awareness and education programmes in order to increase the community collaboration. The summary of the application of situated learning theory is indicated in Figure 6.3.

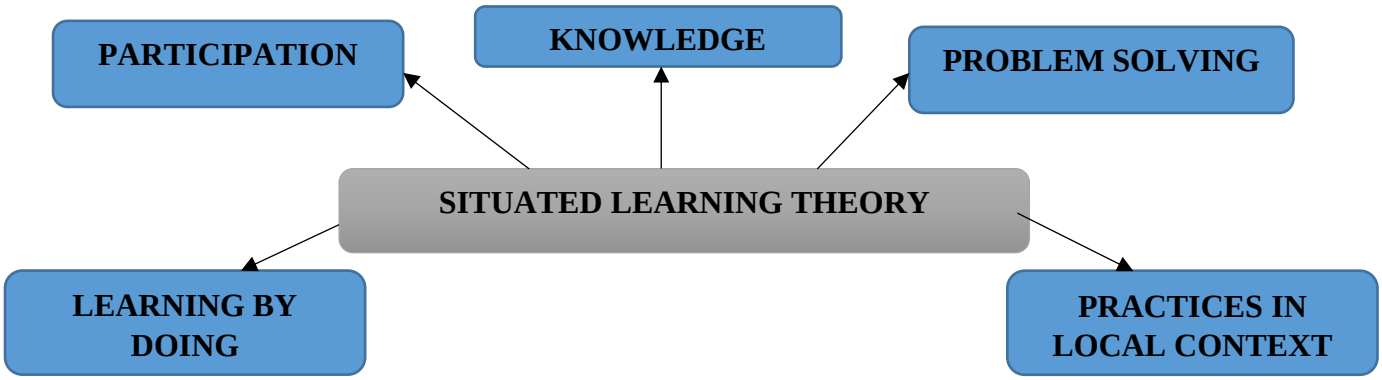

Figure: 6.3 Application of Situated Learning (ST) theory

Source: (Field data, 2017).

The Figure 6.3 showed the theoretical underpinnings were pastoral farmers could be engaged through their involvement in local participation, acquiring of new knowledge, and learning by doing, innovative practices in their local context and emphasis on problem solving that exist.

6.12 Chapter Summary

The chapter provided the detailed discussion on the results of the perceptions of pastoral farmers on the effects of climate variability in Sinazongwe from 2001 to 2016. The study explained that pastoral farmers have perceived changes such as reduction of precipitation affecting the availability of water, onset of rainfall season, shortened rain season, change of wind, increasing in the loss of pasture, increase in temperature, and reduction of cold season and increasing the hot season. The study investigated the perceptions of pastoral farmers toward the effects of climate variability which they observed were as a result of the numbers of years they stayed, the level of education, increasing loss of livestock, increase in temperature and heat stress and the number of years practicing pastoral farming.

The effect of Climate Variability (CV) on pastoral farming were noticed among pastoral farmers in Sinazongwe District. The challenge caused a lots of problems to pastoral farmers were they experienced an increase in the loss of livestock. It involved shortage of water,

temperature variability, lack of good and quality pasture, increasing in floods, and occurrence of droughts, increases in pest and animal diseases and heat stress. The pastoral farmers employed diverse coping and adaption measures such as sinking of borehole to address the diminishing availability of water, construction of dam for water storage, selling of cattle to increase their capital, herd management by keeping a small size of animals per household for easy management, restocking, crossbreeding techniques, dipping of animals and extension services by veterinary and agriculture camp officers. In addition, pastoral farmers also used water from the well in dry season, local stream, grazing rotation, forage, mobility management, tradition strategies and utilised the Lake Kariba as a main source of water. The proposed educational programme is necessary to provide knowledge about climate variability among pastoral farmers and local people to increase their adaptive capacity.

CHAPTER SEVEN

CONCLUSION AND RECOMMENDATIONS

7.1 Introduction

The previous chapter presented the discussion of the findings in terms of investigating the perceptions of pastoral farmers on the effects of climate variability on pastoral from 2001 to 2016, it examined the effects of climate variability to pastoral farming, determined the existing coping strategies among pastoral farmers and proposed a Climate Change Education Programme (CCEP) for Sinazongwe District. This chapter presents the conclusions and recommendations of the study based on the findings of the study. The main purpose of the study was to propose a Climate Change Education Programme to address the effects of climate variability on pastoral farming in Sinazongwe District.

7.2 Conclusion

Firstly, it established the perceptions of selected participants toward the effects of climate variability on pastoral farming for the period of fifteen (15) years from 2001 to 2016, outlined the effects of climate variability among pastoral farmers. Further, ascertained the existing coping strategies being utilised by pastoral farmers and proposed a Climate Change Education Programme for pastoral farmers in Sinazongwe District to address the effects of climate variability. The study also explained the role government and stakeholder in CCEP in order to improve and enhancing of pastoral farming development in the 21st Century and beyond.

In this regard, the study revealed that most of the pastoral farmers had knowledge and understanding on the perception of effects of climate variability on pastoral farming. It was established that pastoral farmers noticed the effects of climate variability in Sinazongwe District through changes in temperature, rainfall pattern, weather season, loss of livestock, increase and decrease in animal diseases and pest. The perceived on the effects of climate variability on pastoral farming was as a results of the number of years stayed and the level of education. It was observed that, those respondents who are educated were able to explain or perceive the changes while the others could not due to illiteracy level and ignorance toward education.

The study also outlined the effects of climate variability on pastoral farming in Sinazongwe District. It was observed and mentioned that, the effects of climate variability on pastoral

farming has increased the loss of livestock. In this regard, the effects of climate variability on pastoral farming includes temperature variability, rainfall variability, increasing and decrease in the occurrence of droughts, increase and decrease in outbreak of diseases and pest. The results also indicated that pastoral farmers situated in the Great Rift Valley or the Zambian Geographical Ecological Zone 1 experience severe effects of climate variability. As reported, Sinazongwe District receive rainfall between 500-800 mm every years contributing challenges on water availability for pastoral farming. The study also revealed that floods and droughts has also led to the increase of water borne diseases and poor quality pasture growth. It was reviewed that temperature variability has increased the breeding of animal diseases and pest and increase in heat stress thereby increasing the loss of livestock. Hence, local livestock are usually dehydrated due to walking of long distances looking for water and good pasture.

The results showed that pastoral farmers were employing local existing coping strategies to the effects of climate variability on pastoral farming in order to increase their adaptive capacity. These strategies which are commonly used by the pastoral farmers includes herd management which involves restocking and crossbreeding of animals, animal control on the number of livestock such as cattle, goat, sheep, pigs, donkeys and poultry. In addition, the use of traditional medicine and modern treatment are common such as dip tank, spraying and BQ vaccinations. Furthermore, pasture management and control is also one of the strategies utilised by pastoral farmers in Sinazongwe District which involves the rotation of grazing areas, selling of animals in the dry season and buying of fodders to feed their animals.

The Proposed Climate Change Education Programme for Sinazongwe District could be appropriate and relevant to address the effects of climate variability on pastoral farming. This entails that pastoral farmers could gain or acquire practical skills, knowledge, values, strategies, applicable adaptation and measures to increase their adaptive capacity toward the challenges being faced. Simply, CCEP is meant for pastoral farmers to improve the pastoral farming. The findings also explain that the programme is appropriate and can be a short, medium or long term were appropriate activities are localised from a broader perspective. In addition, It could contribute and enhance the development of pastoral farming, reduce the poverty level, illiteracy and ignorance toward the growing of pastoral farming or rearing of livestock. Further, the government and other relevant stakeholders have the responsibility to create an enabling environment for both pastoral farmers and the members of the community to have a meaningful situated learning.

7.3 Recommendations

i. The findings shows that there is no educational or training resource centre meant for farmers to get correct information. Therefore, the Government through the Ministry of Agriculture, Livestock and Education are required to set up a pastoral farming training resource centre in each zone that could facilitate and improve the knowledge base for the local people to understand the effects of climate variability and other related farming issues.

ii. The findings indicate that some pastoral farmers are not in cooperative block. The Ministry of Agriculture, Ministry of Livestock and Local Leaders need to enhance and promote cooperative among pastoral farmers in order to improve communication and access to agriculture inputs

iii. The findings show that there is little veterinary services in Sinazongwe District due to lack of resources, poor road network and communication. The Government through the Ministry of Agriculture, and Ministry of Livestock are required to employ more public officers (Veterinary officers, Agriculture officer, Livestock Officers and Extension officer) in Sinazongwe District in order to reduce the shortage of man power (human resources) and enhance the combating on the occurrences of animal diseases.

iv. The findings indicate that pastoral farmers had lack or no access to credit or financial loans or grant to support their activities. The Ministry of Finance and Agriculture should partner with other financial institutions to support local farmers by providing loans and grants in order to improvement agriculture services in Sinazongwe District.

v. The findings show that there has been an increase in the loss of livestock in the area in the last two decade. The Government, Civil Society Organisation and other stakeholders must collaborate in developing a comprehensive District Agricultural Strategic Plan and Framework to facilitate the improvement of pastoral farming for the next generation despite changing climate.

vi. The findings also show that there are few dams or reservoirs for water storage especially in the Northern part of Sinazongwe District. The study recommends the Ministry of

Agriculture and Disaster Management Unit to construct dams in Sinazeze, Mweemba and Buleya Malima Zone specifically for pastoral farming to reduce lack of access to clean and availability of water. This may led to sustain the farmers in long drought seasons and reduce animals walking long distance in search of water presently and in future.

vii. The study shows that there is no active committee or unit dealing with local disaster in Sinazongwe District. The District Agriculture Office must set up a local disaster and emergence unit that could be used to inform local farmers on how to combat and assist in climate change and variability adaptation and mitigation programmes.

viii. Sinazongwe Districts is one of the most vulnerable to climate variability and climate change in the country, the findings show that it only have two meteorological station. In this regard, it's recommended that, there is an urgent need for installation of a three more meteorological station in Sinazongwe District in order to have long term and informed climatic data for the sake of further research. This must be done by the Government under the Ministry of Communication and Information (Meteorological Department of Zambia) and Local District Agriculture office.

7.4 Future Research

i. The findings shows that there are few studies in the field of pastoral farming. Therefore, there is need to conduct more researches on the effects and adaptations of climate variability among pastoral farmers in order to create the knowledge base for the local people and country. The knowledge could be necessary to the researchers, policy makers, media, institutions and educators.

ii. The findings shows that there is little knowledge on pastoral farming among local people. The Ministry of Education and Agriculture must access local knowledge and perceptions of farmers on climate change and variability in the field of pastoral farming in order to design relevant policies and framework.

iii. The findings shows that there is no educational programme in the area meant to sensitize and educate the people on environmental issues such as climate change and biodiversity. The Ministry of Agriculture and Ministry of General Education should implement the Climate Change Education Programme into the Zambia Education Curriculum since Climate Change and Variability have become a national and global social concern or problem. Further, the study recommends to creating a position for Environmental Educators to work in the Ministry of Agriculture as Community Education Officers.

iv. The study also indicated that the role of stakeholders in addressing the effects of climate variability on pastoral farming is not clearly defined or stated. Therefore, it's recommended that policy makers assess the role of stakeholders in Climate Change Educational Programme in Sinazongwe District.

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APPENDICES

APPENDIX 1
PASTORAL FARMERS IN SINAZONGWE DISTRICT
SEMI -STRUCTURED INTERVIEW GUIDE

Name of Zone ……

Sex: Male …… Female ……......

Estimated Number of cattle or livestock owned ……

Section A: Perceptions of pastoral farmer on the effects of climate variability on pastoral farming (2001-2015) in Sinazongwe District.

1. Do you understand by the term climate variability?
2. What are your perceptions on climate variability on pastoral farming in the past 15 years in your area?
3. What is your perception of pastoral farming in the area now than before?
4. For how long have you been experiencing the climate variability on pastoral farming in the area?
5. What could have been the most climate variability trends in the area in the last 15 years
6. What is your perception on the effects of climate variability in the future on pastoral farming?

Section B: Effects of Climate Variability on Pastoral Farming

1. Do you know any effects of climate variability on Pastoral farming in the area?
2. What are the effects of climate variability on pastoral farming in the area?

Section C: Existing Coping Strategies among Pastoral Farming

What are the existing coping strategies you have been using to adapt to effects of climate variability in the area?

3. Do you think the existing coping strategies have increased the local pastoral farmers to adapt to effects of climate variability?

Section D: Proposing a Climate Change Education Programme to address effects of Climate Variability.

4. Is it necessary to propose a climate change education programme to address the effects of Climate Variability in your area?
5. Do you have any existing learning programme in the area about how to increase the adaptive capacity to effects of climate variability on pastoral farming?
6. If yes? What programme do you have in the area?
7. If No? What have you been using to adapt to effects of climate variability on pastoral farming?
8. Who can be responsible to teach you the programme you have outlined in order to address the effects of climate variability on pastoral farming?
9. For how long should be the programme be taught to you?

APPENDIX II:
SEMI -STRUCTURED INTERVIEW GUIDE FOR ADMINSTRATORS (MINISTRY OF AGRICULTURE AND LIVESTOCK, DISTRICT COMMISSIONER AND DISTRICT VERTINARY OFFICER)

Introduction

Sinazongwe district is located in the Agro-Ecological Region I (AER) which covers the Western and Southern part of Zambia. The district has faced extremely impact of climate change for the past two decade which has led to the dearth of livestock farming. The research is seeks to develop a Climate Change Education Programme to address the effects of Climate Variability on pastoral farming since there has not been any research topic as Climate Variability issues are still new global environmental problem which has heightened serious debate.

Part 1

Personal information

1. How long have you stayed in Sinazongwe District?
2. What is your income rate?-
3. What is your level of education?
4. Are you married or not?
5. For how long have you been doing pastoral farming in Sinazongwe District?
6. Approximate, how many herd of cattle, goats, sheep or any other animals do you have?

Part 2

Section A: The Perceptions of Climate Variability among Pastoral Farmers in the last 15 years period

1. Do you understand by the term climate variability?
2. What are your perceptions on climate variability on pastoral farming in the past 15 years in your area?
3. What is your perception of pastoral farming in the area now than before?
4. For how long have you been experiencing the climate variability on pastoral farming in the area
5. What could have been the most climate variability trends in the area in the last 15 years
6. What is your perception on the effects of climate variability in the future on pastoral farming?

Section B: Effects of Climate Variability on Pastoral Farming

7. Do you know the effects of climate variability on Pastoral Farming?

8. What are the effects of climate variability on pastoral farming you have been facing in the area?
9. Which one is the most common effects of climate variability among pastoral farmers
10. Do you think effects of climate variability are the major reason for the loss of pastoral farming or livestock in in the area?

Section C: Existing coping strategies to effects of climate variability among pastoral farmers

11. What are the existing coping strategies to climate variability among pastoral farmers in Sinazongwe District?
12. Which one is the most appropriate and common method being used by farmers among all existing coping strategies.
13. What has the government done to address effects of climate variability on pastoral in the area?
14. What are the newly existing coping strategies that farmers uses to address the effects of climate variability on pastoral farming in the area?

Section D: Proposing a Climate Change Education Programme to address impact of climate variability

15. Is it necessary or appropriate to develop a Climate Change Education Programme for pastoral farmers as a way of addressing the effects of climate variability in Sinazongwe District?
16. If Yes? What programme do you think pastoral farmers should learn that can be included in the programme as a way to increase the adaptive capacity to climate variability?
17. For how long should be the programme be?
18. Who should be responsible in the implementation of Climate Change Education Programme among pastoral farmers
19. What should be the major goal and objective of the programme in order to increase the knowledge of pastoral farmers to effects of climate variability?
20. If No? What can be done?
21. You can add any information that is relevant to the topic

APPENDIX 1II

FOCUS GROUP DISCUSSION WITH PASTORAL FARMERS

Section A: The Perceptions of Climate Variability among Pastoral Farmers in the last 15 years period

1. Do you understand by the term climate variability?
2. What are your perceptions on climate variability on pastoral farming in the past 15 years in your area?
3. What is your perception of pastoral farming in the area now than before?
4. For how long have you been experiencing the climate variability on pastoral farming in the area
5. What could have been the most climate variability trends in the area in the last 15 years
6. What is your perception on the effects of climate variability in the future on pastoral farming?

Section B: Effects of Climate Variability on Pastoral Farming in Sinazongwe District

7. Do you know any effects of climate variability on pastoral farming in the Sinazongwe?
8. What are the effects of climate variability on pastoral farming in the area?
9. For how long do this effects on climate variability been existing in the area

Section C: Existing Coping Strategies to effects of Climate Variability among Pastoral Farmers

10. Do you know any existing coping strategies to address effects of climate variability on pastoral farming?
11. What are the existing coping strategies among pastoral farmers to adapt to effects of climate variability?
12. What have you done to adapt to the effects of climate variability on pastoral farming in the area?

SECTION D: Proposing a Climate Change Education Programme for Pastoral Farmers in Sinazongwe District.

13. Do you think it is appropriate to develop a climate change education program to address effects of climate variability on pastoral farming in the area?
14. What kind of programmes that can be learned to increase the adaptive capacity among pastoral farmers in the area?
15. What can pastoral farmers do to address effects of climate variability in the area?

16. What should the government and other stakeholder do to increase the adaptive capacity among pastoral farmers to address the effects of climate variability?
17. Add more information if you have any?

Appendix IV

Observation Guide

Areas to be observed by the researcher

➢ **Dam**	➢ **Grazing Place**
➢ **Boreholes**	➢ **Dip Tank**
➢ **Streams**	➢ **Lake Kariba**
➢ **Grazing Land or area**	➢ **Household Inspection**
➢ **Vaccination place / Kamado**	➢ **Meteorological stations**
➢ **Livestock ranching in Chief Mweemba**	➢ **Sinazongwe Buchi agriculture area (Forage)**

Appendix V

Consent Letter

THE UNIVERSITY OF ZAMBIA
SCHOOL OF EDUCATION
DEPARTMENT OF LANGUAGE AND SOCIAL SCIENCES EDUCATION
ENVIRONMENTAL EDUCATION AND GEOGRAPHY UNIT

TO WHOM IT MAY CONCERN

Dear Respondents,

Ref: Request for Your Participation in Research

The Subject matters above refers**.**

This research will be conducted by bona-fide Master student of the University of Zambia in partial fulfilment of a Master's Degree in Environmental Education. The purpose of this research therefore, is to develop a climate change Education Programme to address the effects of climate variability in Sinazongwe District of Southern Zambia. In this regard, you have been randomly selected to be part of the sample size and thus, your full participation as a respondent is cardinal to this research. This research is strictly for academic purpose only and thus, the information collected is only for successful completion of the study. All information and data collected will be handled with confidentiality. Therefore, no names will be used in this research for security reasons and photographs will only be taken after requesting from the owner and permission granted. The data which will be collected is purely used for academic purpose. Additionally, you are requested to feel free to ask any queries concerning your participation in this research study. I will be glad and grateful to answer them and assist where need may arise.

Your assistance will be highly appreciated.

Yours Faithfully
Dr. L. Mweemba (Supervisor)