

# DEVELOPING A CLIMATE CHANGE EDUCATION PROGRAMME TO ADDRESS EFFECTS OF CLIMATE VARIABILITY ON PASTORAL FARMING IN SINAZONGWE DISTRICT OF SOUTHERN PROVINCE, ZAMBIA

*Simpilo Syabwanta and Dr. Liberty Mweemba*

1. [simpilo.syabwanta@gmail.com](mailto:simpilo.syabwanta@gmail.com) 2. [Lmweemba69@gmail.com](mailto:Lmweemba69@gmail.com)

*Department of Languages and Social Sciences Education, School of Education*

## **Abstract**

The purpose of the study was to examine the effects of climate variability on pastoral farming and develop a Climate Change Education Programme (CCEP) to address the effects of Climate Variability on Pastoral farmers in Sinazongwe District of Southern Province of Zambia. The study was purely a qualitative guided by the methodological framework through a single case study. Data collection tools that were employed involved semi-structured interviews, Focus Group Discussion, Direct and Participant observations by using heterogeneous sampling, purposive sampling, convenient and expert sampling to select the 70 respondents. These included 45 households' pastoral farmers, 10 Agricultural Officers and Veterinary officers, 15 local leaders. The study shows that pastoral farmers were aware and had knowledge on the effects of climate variability to pastoral farming. Pastoral farmers had observed climate variability's through increase in drought prevalence, changing rainfall pattern or precipitation, change in temperature, increase in diseases, pest and wind direction and occurrence. In this regard, education strategies are appropriate to address to increase the adaptive capacity among pastoral farmers to cope with effects of climate variability.

## **1.1 Background**

There has been and there is still an extra-ordinary heightened tension, concerns and serious debate around the world on Climate Change and Variability. It is a true story of the 21st Century in which every group of people in the street, community, political leaders, business people, academic scholars and many others talk about the effects of climate variability in their respective areas or as a country. It has become a buzz-word in our society thereby no one can contradict or deny about the reality of the effects of Climate Variability (CV) and Climate Change (CC) being faced around the world. Today, 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 (IPCC, 2007). The challenges the country been experiencing had affected the growth of pastoral

farming and well-being of the people as a source of their livelihood. Pastoral farming as part of the agriculture sector been degraded and not utilised as it was previously, thus endangering the present and future generation in Zambia due to its poor contribution to the economic growth and national development. In this regard, there had been little or no serious adaptation strategies and programmes at global, continental, regional and country level that are designed with a purpose to address the increase effects of climate variability on pastoral farming. Henceforth, the existence of extension services had proved not futile to improve the status quo among pastoral farmers by increasing their coping and adaptive capacity in Sinazongwe District. In addition, prior studies had explained much on the perceptions of pastoral farmers, effects of climate change and variability and existing programme without proposing an educational strategies to address or curb the emerging problem that exist in the local context.

## **1.2 Environmental Education (EE) context of the study**

According to the 4th conference on Environmental Education (EE) held in Ahmadabad in 2007, climate change is deemed to be one of the most important issues facing humanity in the 21st Century and beyond. It is a complex issue that must never be viewed from a linear perspective but in a broader picture because of being interlinked in nature (UNESCO, 2007). According to the 4th conference on Environmental Education held in Ahmadabad in 2007, Climate Change and Variability was deemed to be one of the most important issues facing humanity in the 21st Century and beyond. It is a complex issue that must never be viewed from a linear perspective but in a broader aspect because most of the issues are interlinked which are holistic and crosscutting issues broadening socio-ecological, political and economic (Muchanga, 2011). “Article number five (5) of the Ahmadabad framework provide on what must constitute Environmental Education (EE) Practice in the 21st Century. Addressing global climate change and variability is now one of the major issue which tops the international political agenda today”. It must be one of the issues that require emphasis in EE (UNEP, 2012). Climate Change Education (CCE) is particularly receiving attention to EE practitioners and researcher and, it is a thematic area that requires recurrent studies within broader frames of EE. In this regard, CCEP could provide the best solution to address the current challenges being faced.

### **1.3 Statement of the Problem**

Although Climate Change Education is one of the new developed strategies that could be used to address diverse impact of climate change as stated by the National Climate Change Response strategy, MTENR, (2012). It still remains one of the least explored approaches to address Climate Change in Zambia. Little has been done to address the impact of Climate Change on pastoral farming through a deliberate Climate Change Education Programme (CCEP) in Zambia, particular in Sinazongwe District. Without an understanding of how Climate Change Education (CCE) could be a relevant tool to address Climate Change, people and pastoral farmers in particularly would continue engaging in Climate unfriendly practices that would heighten already changing climate. There would also be no behavioural and social change among pastoral farmers in the areas to promote Sustainable adaptation to Climate Change and Community Adaptation Capacity. Hence, this study intend to contribute to the existing knowledge gap by designing a Climate Change Education Programme meant to address the adverse effects of Climate Change on pastoral farming through a deliberate community learning programmes to enhance adaptive capacity among pastoral farmers in Sinazongwe District of Southern in Zambia.

### **1.4 Specific Objectives**

The objectives of the research include the following:

1. To examine the effects of climate variability on pastoral farming in Sinazongwe District.
2. To develop a climate change education programme to improve pastoral farming adaptive capacity to the effects of climate variability in Sinazongwe District.

### **1.5 Significance of the study**

The study developed a programme on CCE which may be useful to pastoral farmers in Sinazongwe District. In line with the Zambia Climate Change Response Strategy (ZCCRS) of 2010, the results of this study may also be useful to decision makers on climate change and, also to EE practitioners because CCE is one of the current issues in the practical context of the latter. Further, climate action is part of the newly Sustainable Development Goal (SDGs) number thirteen (13) which is a Global Goal building success from the Millennium Development Goals (MDGs) with set target to be attained by 2030 to improve life in a sustainable way for future generation by tackling pressing challenges facing our world today.

Hence, this study would support the 2030 Agenda as a top priority by UNDP in designing an education programme as one of the urgent action to combat climate change and variability and, its effects among pastoral farmers. 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 is expected to help the following institution in the country 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 in putting up in place an appropriate, relevant and practical Climate Change Education programme, plans and short and long terms strategies meant to address the effects of climate variability and change on pastoral farming.

## **2.0 Methodology**

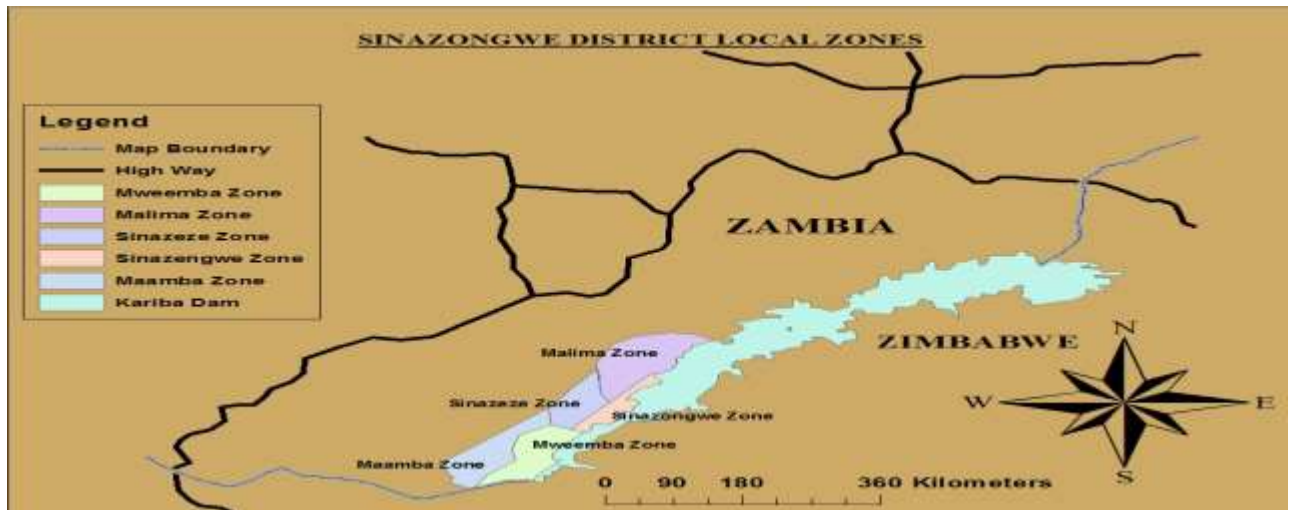
### **2.1 Description of the Study Area**

The study was undertaken in Sinazongwe district situated in the Southeast 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. Further, the district shares its borders with Choma district to the west, Gwembe district to the north and Kalomo district on the south western border and comprise of two Chiefdoms such as the Sinazongwe and the Mweemba. Further south, lies the national boundary with Zimbabwe which borders with Lake Kariba. The district covers approximately 4200 square kilometres and distanced approximately 220 km from Lusaka and 180 km from Livingstone (CSO, 2011). Its approximated altitude of elevation above the sea level is 537 meters. The district is known by smallholder agro-pastoral farming system in which livestock being kept consists of cattle, goat, sheep, donkeys and domestic animals. Mixed farming is well known and practiced by the farmers and agro-pastoralists were sorghum, maize, millet and cotton are crops cultivated in the area. Furthermore, the location of Sinazongwe District lies on the Zambia Ecological Zone 1 that receive rainfall below 800 mm. The annual mean temperature of the district is approximately in the range of 37-42°C.

## 2.2 Location of Zones in Sinazongwe District

The 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.

**Figure 2.1 Location of Zones in Sinazongwe District**



Source: (CSO 2010 and ZMD, 2010).

## 2.2 Research Method

The methodology of the study was purely qualitative in nature guided by critical realism in a post positivism paradigm. The study employed a single case study and the target population were pastoral farmers, local leaders, agricultural and veterinary officers and headmen. Purposive, heterogeneous, expert, simple randomly and convenient sampling were used. The sample size of the study was 70 from all the selected five zones in Sinazongwe District. In this regard, semi-structured interviews was administered to respondents from all the Zones using the objectives. Hence, the researcher used a note book to record the views or responses from the selected respondents. The study conducted two focus group discussion in the study area were one was held in Sinazongwe and the other in Maamba Zone. Moreover, participates of the FDGs were selected pastoral farmers and local leaders within the Zones.

Further, both direct and participant observation were utilised to collect data in the research survey the area posed to have experienced the effect of climate variability. These area include visited local streams, dip tanks, pasture areas, Lake Kariba, boreholes and wells being used by pastoral farmers as a source of drinking water. Further, the researcher observed and participated in the BQ vaccination with local pastoral farmers in Maamba Zone in Siakondobbo Village where there was a reported outbreak of diseases and pests. The results

obtained from the respondents were analysed thematically using the objectives were sub-themes were generated and categorised. In addition, between methods triangulation was employed to check, validate and assess the reliability of information obtained from multiple sources in the study.

### 3.0 Findings

#### 3.1 Demographic Characteristics of Respondents

The socio-economic characteristics such as gender, educational level, occupation, monthly incomes, duration of respondents stay in the study area, the approximately number of livestock they have were investigated as a way of providing the background information to the research study. These were studied to provide the general characteristics of the study population.

**Table: 3.1 Socio-demographic characteristics of respondents**

Demographic characteristics of respondents		Frequency	Percentages
<b>Gender</b>	Male	57	81
	Female	13	19
<b>Education</b>	Not been to school	12	17
	Primary	9	13
	Secondary	30	43
	Tertiary	19	27
<b>Occupation Status</b>	Self employed	40	57
	Employed	21	30
	Not Employed	9	13
<b>Year of Staying</b>	0-5	6	9
	5-10	12	17
	10-20	36	51
	Above 20	16	23
<b>Approximate Number of Livestock per Household.</b>	0-20	11	16
	20-50	16	23
	50-100	28	40
	Above 100	15	21

As shown in the above Table 3.1, of all 70 respondents 57 (81%) are male while the remaining 13 (19%) are female who were participated in the study from all the selected

zones. This table shows that the male respondents were the majority in participating. The level of education among all respondents showed that 30 (43%) had gone up to secondary level, 19 (27%) represented respondents who had gone to tertiary level, 9 (13%) represent respondents who did only up to primary level and lastly 12 (17%) respondents did not go to school. On the level of education, some respondents were educated while other are not due to social problem such as poverty in the area. In addition, the employment status showed that 40 respondents (57%) were self-employed, 21 respondents (30%) were employed and 9 respondents (13%) who were self-employed. The study shows that most of the respondents are self-employed were they are engaged in economic activities such as crop farming, fishing business and selling of cloths and other business ventures to earn a living.

As indicated in the Table 3.1, 16 respondents (23%) who had stayed in the areas for 20 years and above, 36 respondents (51%) had stayed between 10 to 20 years in the area. Further, 12 respondents 17% have stayed in the area for 5 to 10 years and lastly 6 respondents (9%) had stayed in the areas for the period of five years or less. Furthermore, the approximate number of livestock per household as indicated that 28 respondent (40%) percent clearly indicated that per household about 50 to 100 number of livestock and 16 respondents (23%) about 20 to 50 estimated number of livestock per house hold. Furthermore, 11 respondents (16%) indicating about 0-20 number and 15 respondents (21%) representing those above hundred per household.

### **3.2 Objective 1: Effects of Climate Variability on Pastoral Farming in Sinazongwe District.**

Sinazongwe district had faced a lot of challenges on pastoral farming due to increasing of climatic variability specifically in the last fifteen years (2001 to 2016). In this regard, pastoral farmers were interviewed on the effects of climate variability on pastoral farming in the area. Therefore, some of the questions which were used to ask respondents to order to attempt the objective are as follows; what are the effects of climate variability on pastoral farming you have been facing in the area? Which one is the most common effect of climate variability and the loss of pastoral farming or livestock in the area is a results of the effect of climate variability?

**Table: 3.2 Effect of climate variability in Sinazongwe District (2001-2016)**

<b>Season</b>	<b>Experienced impact of climate variability among pastoral farmers.</b>
<b>2000/01</b>	Increase in floods, temperature change, poor pasture, increase in the loss of livestock
<b>2002-03</b>	Occurrence in droughts, increase in the death of livestock, change in rainfall patterns, diseases and pest, temperature increase
<b>2004-06</b>	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
<b>2007/09</b>	Floods occurrence, increase in temperature, loss of livestock and short cold season
<b>2010-11</b>	Increase in floods, pasture growth affected, loss of livestock was experienced and temperature increase.
<b>2012-2014</b>	Short cold season, long hot season, flash of floods, increase in temperature and delayed rainfalls
<b>2015-2016</b>	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)

Table 3.2 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 in the area as outlined in the above Table.

The response from one of the respondents was asked on the effects of climate variability on pastoral farming in Sinazongwe District and had this to say:

*“Banyama aba ba penga maningi alimwi zyafwa loko okuno akaambo kakupya kwaindilila chobeni kwinda myeka yainda okuno which could be*

*translated as livestock had suffered and had died a lot because of increasing heat and temperature than previous years in the area*". **(During interview with Pastoral farmers).**

Another respondent had lamented this on the same question asked by the researcher to explain the effects of climate variability on pastoral farming in their area:

*“As a District Veterinary Officer, there had been un-stable rainfall precipitation/ variation in Sinazongwe district for the last 20 years. The decline of water and water quality in the area especially in the Northern part of the District which consist of (Maamba Zone, Sinazeze and part of Buleya Malima Zone) that had caused the increase in the outbreak of diseases and a lot of animals had died from the diseases such as anthrax, black leg and tick and mouth. (Interview with the District Veterinary Officer).*

### **3.4 Objective 2: Developing a Climate Change Education Programme 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 skill to the local pastoral farmers in order to increase the coping and adaptive capacity in the area.

**Table: 3.4 Respondents responses on the Educational Strategies to address the effects of Climate Variability**

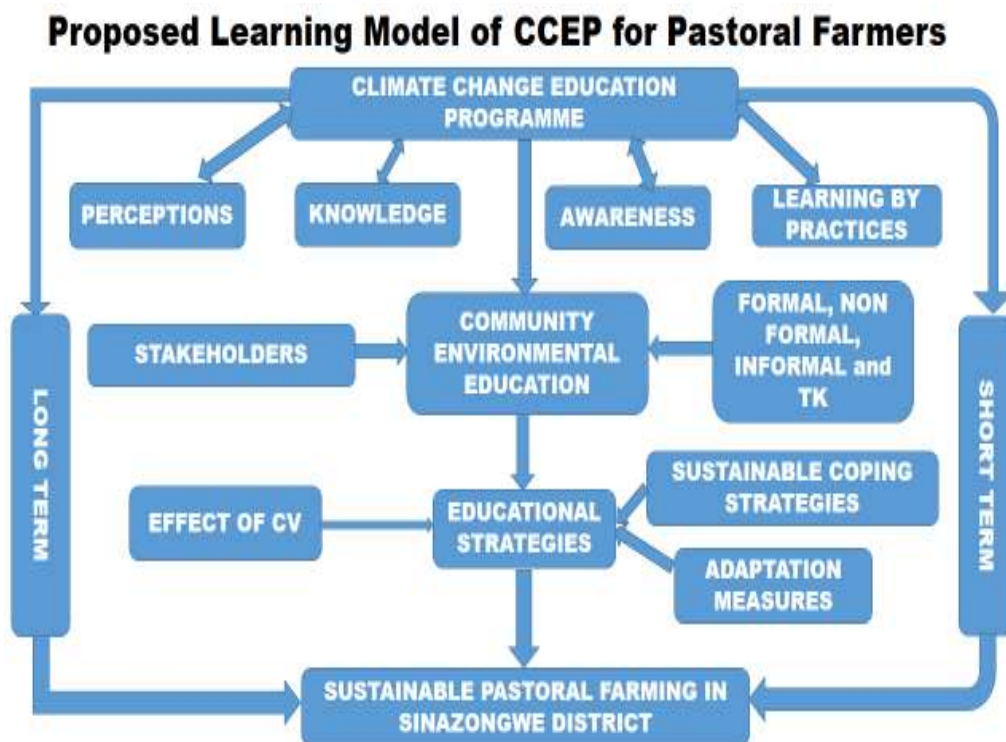
Educational Strategies	Frequency	Percentages
Formal education	15	21
Non formal education	33	48
Informal education	7	10
Traditional education	3	4
Media	1	1
Community gatherings	8	12
Extension Services	3	4

Sources: (Field data, 2017).

Table: 3.4 showed that majority of 33 respondents (48%) suggested Non Formal Education as one of the appropriate educational strategies that could be used among pastoral farmers to

impart to address the problem in the area. Non formal education involves seminars, local training programmes, workshops and lesson conducted from outside environment with a facilitator. In additional, 15 respondents (21%) mentioned that formal education is also a good strategy that could be utilised. This could involve teaching and learning of pupils and students in a classroom environment about how pastoral farming could be improved despite facing effects of climate variability. Further, 3 respondents (4%) stated that extension services offered by agriculture officers could still be utilised in order to give the information patterning to disease on livestock and how to solve the problem. Lastly, 1 respondents (1%) acknowledged the use of public and private media as an educational tool necessary to inform pastoral farmers on how to cope and address the effects of climate variability.

Figure: 3.1 presents the developed model of CCEP for pastoral farmers of Sinazongwe District. During the interviews, respondents mentioned that the program should increase the awareness, understanding and knowledge. The use of localised educational strategies to increase the adaptive capacity among pastoral farmers should be involve major stakeholders and target groups in the learning process both in the short or long term to achieve a sustainable pastoral farming. Situated learning would increase the understanding and solve local problems through engagement and participation of the people in the learning process.



Source: (Field data, 2017).

## **4.0 Discussion of Findings.**

### **4.1 Effects of Climate Variability on Pastoral Farming in Sinazongwe District.**

#### **4.1.1 Rainfall variability**

The study showed that most of the pastoral farmers in the area 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. Further, the study revealed 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 agrees with studies conducted by IPCC, (2007), MDZ, (2010) and Juana *et al.*, (2013) indicated that Sub Saharan Africa was among the most vulnerable regions to climate change and variability especially in the agriculture sector.

#### **4.1.2 Temperature variability**

The study showed that, there was temperature variability in the area, thus it was becoming hotter than in the previous years. The respondents further revealed that from the year (2001-2004) and (2013-2015) had experienced high levels of temperature from the months of July to November yearly in the area resulting to increase in the loss of livestock. This showed a different from the previous experience among pastoral farmers when the area had high temperature which was in the months of September and to early November before the rainy season start. The changes had greatly affected the growth of pastoral farming. Pastoral farmers preferred to keep goat, pigs and sheep than cattle in the area because they can survive in a long dry spell. The findings agree with the study conducted by Nhemachena and Hassan (2007), reviewed changes in temperature in Southern Africa that include Zambia being affected by climate variability on the agriculture sector in the region (inclusively pastoral farming).

### **4.1.3 Increased diseases and pests.**

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 revealed that pastoral farmers had faced harsh diseases in the warmer period (dry season) from August to November yearly. It was noted that due to increase in temperature and lack of water, most of the livestock been losing weight and eventually dies. In addition, heat stress among livestock had been experienced in the due to the increase of temperature affecting pastoral farming production. therefore, the study findings concurs with prior studies conducted by Harvell *et al.*, (2002); Karl *et al.*, (2009); Patz *et al.*, (2000) and Thornton *et al.*, (2009) on pastoral farming in East and Southern Africa, South America and Asia were temperature variability 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 as well as heat stress affecting the rearing of livestock.

### **4.2 Developing a Climate Change Education Programme (CCEP) to address effects of Climate Variability (CV).**

The study established that Non formal education could be the best educational strategy to address effects of climate variability. It was established that local pastoral farmers could gain appropriate knowledge through participating in organised meeting, seminars, workshop and community learning to bring about awareness and skills thereby increasing their adaptive capacity. NFE involves learning that take place outside the classroom environment were all target group and learners such as pastoral farmers, headmen, chiefs, community leaders, councillors, government and others who are taught and informed on how to address the problems. In this regard, Article 6 of the UNFCCC, (2007) directs countries to consider education, training and public awareness as integral response to climate change and variability. Increasingly, country plans developed utilizing the UNFCCC framework to incorporate education-specific elements.

The study argues that there had been no permanent educational strategy for pastoral farmers in Sinazongwe District meant to increase their knowledge on how to improve rearing of livestock and increase their coping and living to effect of climate variability in the area. The study revealed that a permanent educational programme would enhance the knowledge among pastoral farmers or target group thereby increasing the practice of sustainable coping

and adaptive strategies. In this regard, Muchanga (2011), proposed a learning programme for small scale farmers in Lusaka Province for both rural and urban community. Hence the programme was too general and not specific to pastoral farming in order to address the climate change in Zambia. Therefore, the proposed CCEP would be appropriate to pastoral farmers both in rural and urban areas in order to increase their adaptive capacity in the changing climatic season being experienced.

## **5.0 Conclusions and Recommendations**

### **5.1 Conclusions**

Pastoral farming in Sinazongwe District had been affected with the effects of climate variability in the last three decades due to the change and variability on climate season. The effects of climate variability on pastoral farming include increase in the loss of livestock, reduction in livestock production and decrease of pastoral farmers caused by an increase in climatic variability. Previously, the area was known as the haven for pastoral farming in the country due to increased number of livestock the local people had per household. Pastoral farmers had experienced shortage of water due to high dependence on rain-fed agriculture, variability on onset rainfall, increase in poor growth and quality of pasture, temperature variability were an increase in months experienced high temperature had increase resulting to increase in animal heat stress, occurrence of diseases and pest that are favourable to the local condition.

Sinazongwe District was one of the district mapped by the Zambia Vulnerability Climate Assessment to experience harsh climate and change variability due to its location in the Zambia Agro Ecological Zone region 1 which could be prone to many environment problem. In this regard, respondents observed that the effects of climate variability had also led to increasing loss of livestock. The study revealed the appropriateness of proposing a CCEP for pastoral farmers in Sinazongwe to address the effects of climate variability. It is noted that, pastoral farmers need permanent educational strategies that could be in cooperated with extension services being offered by agriculture and veterinary services.

The programme would enhance community learning throughout by increasing participating, collaboration, and decision making and understanding the effect of climate variability. This could foster coping and adaptive capacity among pastoral farmers thereby increasing the rearing of livestock. Furthermore, the proposed educational strategies might possibly reduce

the knowledge gap and skills existing among local people as a result of poor literacy level. Moreover, the study also established that stakeholders would be involved in the teaching and learning both in the short and long term process. In this regard, the proposed CCEP learning model would contribute positively to the development of pastoral farming in the area.

## **5.2 Recommendations for policy makers**

- There is need to improve veterinary services in the district. The government through the Ministry of Agriculture and Livestock to employ more public officers in Sinazongwe district in order to reduce the occurrences of diseases.
- There is need to improve access to financial loans and empowerment fund in order to enhance sustainable pastoral farming in the area. Local banks and Ministry of Agriculture should partner in implement the plan or strategies.

## **5.3 Recommendation for future research**

- To conduct more researches on the effects and adaptations of climate variability among pastoral farmers in the country in order to create knowledge base for the local people and country. The knowledge will be necessary to the researchers, policy makers, media and educators
- To access the knowledge and perception of farmers on climate change and variability to pastoral farmers.
- To implement the Climate Change Education Programme into the Zambia Education Curriculum since climate change and variability are a national and global problem.
- There is need to implement climate education programmes among pastoral farmers in the District to promote and enhance water conservation, livestock management, pest and diseases control and pasture control.
- To assess the role of stakeholders in the implementation of CCEP in Sinazongwe district.

## REFERENCES

- Central Statistical Office (CSO) (2010). *Census of Housing and Population*. CSO, Lusaka.
- GRZ. (2004), *National Agricultural and Cooperatives Policy [NACP] 2003-2015*.
- Harvell, C.D., (2002). *Climate warming and disease risks for terrestrial and marine biota*  
*Science*, 296 (2002), pp. 2158-2162.
- Intergovernmental Panel on Climate Change (IPCC). (2007). *Climate Change 2007: Impacts, Adaptation and Vulnerability. Summary for policy makers*. 5/5/2012.  
<http://dx.doi.org/10.1017/CBO9780511546013>.
- Juana J, Kahaka, Z and Okurut F. (2013). *Farmers' perceptions and adaptations to climate change in sub-Sahara Africa: a synthesis of empirical studies and implications for public policy in African agriculture*. *J Agric Sci*. 2013; 5: 121–135.
- Mertz, O., Mbow, C., Reenberg, A., & Diouf, A. (2009). *Farmers' Perceptions of Climate Change and Agricultural Adaptation Strategies in Rural Sahel*. *Environmental Management*, 43(2009), 804-816.
- Meteorological Department of Zambia (MDZ) (2010). *Agro-ecological Map and Climatic Data*. MDZ: Lusaka.
- Ministry of Tourism, Environment and Natural Resources (MTENRs) (2007). *National Adaptation Programme on Action-NAPA*. Lusaka: MTENRs.
- MTENRs (2010). *National Climate Change Response Strategy-NCCRS*. MTENRs: Lusaka.
- Muchanga, M. (2011). *Perceptionzs of Climate Change Adaptation and Learning among residents of selected areas of Zambia's Lusaka province*. UNZA Press: Lusaka.

- Nhemachena, C., & Hassan, R. (2007). *Micro-level Analysis of Farmers' Adaptations to Climate Change in Southern Africa*. IFPRI, Environment and Production Technology Division. Washington, DC: International Food Policy Research Institute.
- Patz, A. (2000). *Effects of environmental change on emerging parasitic diseases*. *Int. J. Parasitol.*, 30 (2000), pp. 1395-1405.
- Thornton P.K, Jones PG, Owiyo T, Kruska RL, Herrero M, Kristjanson P, Notenbaert A, Bekele N, Omolo A (with further contributions) (2006) *Mapping Climate Vulnerability and Poverty in Africa*. Report to the Department for International Development. The International Livestock Research Institute, Nairobi, Kenya.
- UNEP (United Nations Environment Programme), (2012). *Global environment outlook 5: Chapter 5*. [http://www.unep.org/geo/pdfs/geo5/GEO5\\_report\\_C5.pdf](http://www.unep.org/geo/pdfs/geo5/GEO5_report_C5.pdf).
- UNFCCC (United Nations Framework Convention on Climate Change), (2008). *Challenges and opportunities for mitigation in the agricultural sector: technical paper*. <http://unfccc.int/resource/docs/2008/tp/08.pdf>.