# Climate Variability Impact on Livelihood Strategies Among Agro-Pastoralists in Southern Province of Zambia

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## ABSTRACT

***Objectives and Study Design:*** The study was carried out in Choma District during the period of March to December 2010 to investigate the effect of climate variability and extreme weather conditions on livelihood coping practices among the agro-pastoralists. Climate data of the study area of a period of fifty years was used. Data on change in livelihood strategies was collected through the use of semi-structured questionnaires and observation. Sixty (60) households from 10 villages were selected for the study.

***Results:*** Climate data revealed that there has been an increase of 1.0 °C in the average annual temperatures over the previous five decades. The rainfall data revealed that there has been an increase variability in the amount of annual rainfall received. However there was a general decline in average annual rainfall received over the same period. The major livelihood adaptable practices for the pastoralists in times of extreme weather conditions are livestock sales and engaging in non-agricultural activities. Harvest of products from the forest such as charcoal burning, sale of firewood, carpentry and carving, as well as sale of thatching grass were the most important non-agricultural livelihood strategy (50.13%), followed by trading 30.51%. The least practiced activities were collection of wild fruits and fishing 1.69%. This means that with increased climate variability there will be more pressure on the forest and forest products. This could lead to de-forestation.

***Conclusion:*** Farmers have an understanding of climatic change and are engaged in various livelihood strategies to adapt to this change in the environment. The farmers should be encouraged to engage in sustainable adaptable livelihood strategies for survival. Harvesting of forest products during extreme weather conditions should be coupled with replanting of these indigenous trees to avoid depletion of the forest and further environmental degradation.

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## INTRODUCTION

Climate variability which refers to the climate changes taking place around the globe can affect the livelihoods of agro-pastoralists in diverse ways. Currently, in Sub-Saharan Africa and Zambia in particular there is lack of knowledge concerning the pastoral production systems and their livelihood strategies in view of climate variability. It is therefore important to understand the climate variability in relation to livelihood strategies so as to appropriately devise adaptation strategies that will be relevant for sustainable development.

Pastoralists have managed their production systems for many centuries and have had detailed knowledge of the biodiversity and environment of their grazing lands. Despite the existence of such valuable knowledge, researchers and development experts have previously deliberately overlooked the indigenous knowledge in the evaluation of rangeland[1]. A combination of pastoral indigenous knowledge and modern scientific information may be helpful in providing a better understanding of the environment from the perspective of those utilizing the resources [2].

The day-to-day impacts of climate change such as higher temperature, erratic rainfall and floods are increasing the pastoralists' inability to feed their animals leading to loss of a source of livelihood and food insecurity. In the horn of Africa millions of people currently leave a lifestyle that is centred on the search for the increasingly scarce pasture and water[3]. For example droughts have the effect of favouring some trees and shrubs while adversely affecting others[4]. Floods have devastating effects on livelihoods destroy agricultural crops, disrupt electricity supplies and demolish basic infrastructure such as roads, homes and bridges. Intergovernmental Panel on Climate Change (IPCC)[5] concluded that climates and ecosystems are already changing as a result of human activities and projected warming of 2 to 2.5 °C and significant impacts on global agriculture and food prices by 2050. It is estimated that by 2050 temperatures will be significantly higher and rainfall will greatly reduce in Southern Africa[6]. The pastoral communities and their livestock are very vulnerable to these ecological disturbances which often result in food insecurities and shortages. These climate change projections if realized,

**Key words:** *Extreme weather conditions, Adaption, Environmental degradation*

are likely to affect forage and animal production, and ecosystem functioning[7]. There is therefore need to understand the impact of climate variability on the change in livelihood strategies of the pastoralists so as to be able to effectively mitigate the negative effects. In view of the above, this study was conducted to determine the livelihood coping practices, as an adaptation to cope with climate variability in order to enhance food security.

## MATERIALS AND METHODS

### *Study Area*

The study was carried out between March and December 2010 in Choma District of Southern province of Zambia. The major inhabitants of the study area are the Plateau Tongas who are mainly agro-pastoralists. The area experiences unimodal type of rain lasting from November to April. Annual rainfall of 600-700mm with an uneven distribution is generally insufficient with 70% probability of drought. The average monthly temperature is about 26°C with a maximum of 32°C in October and a minimum of 15°C in June

### *Sources of Data*

Both primary and secondary data were used in this study. The primary data was collected using semi-structures questionnaires and personal observations. The secondary data was from Meteological Department of the Ministry of Environment and Natural Resources.

### *Method of Data Collection*

The study was carried out in ten (10) randomly selected villages in Choma district. The villages were Masopo, Siakacheka, Siachimputi, Siabbwenungu, Siamungala, Siazweni, Simuchembu, Simweemba, Kaluwe and Namonza. Five (5) to ten (10) households from each village were randomly selected depending of the number of households in each village. A semi structured questionnaire was administered to the farmers.

### *Data Analysis*

Frequencies and percentages were computed from the data gathered using GenStat Discovery Edition 3 software program and Microsoft Excel and presented as tables and pie charts.

## RESULTS

### *Age and Gender Distribution of the Respondents*

The study revealed that 94.92% of the agro-pastoralists in the study area were males and 5.08% females. The majority of the agro-pastoralists (53.45%) were between the ages of 40-60, 25.86%, were between the ages of 30-39 whilst 20.69% were above 60 years. Of the respondents 68.96% were in monogamous marriages, 29.31% in polygamous marriages whilst 3.44% were single. This shows that polygamy is still very prevalent in the area. This is revealed in the fewer number of female respondents since most of the households are male headed. Most of the females are normally married off even to already married men.

### *Agricultural Activities*

All the respondents were involved in mixed farming which involves the growing of crops and the rearing of livestock. The main crops grown are maize the staple crop, groundnuts, sweet potatoes and cowpeas. The major livestock reared are cattle, goats and chickens with cattle being the most important as per Tonga Tradition. The other agricultural activities practiced by the farmers as shown in figure 1 are gardening (62%), fruit growing (19%), bee keeping (15%) and fishing (4%). All of these agricultural activities have a direct relation to climatic conditions and any climatic deviation from the normal would adversely affect production.

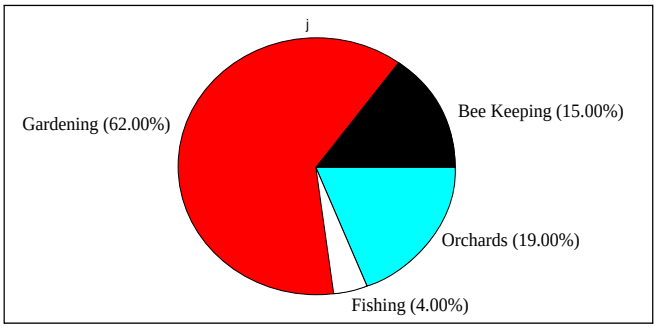


***Figure 1:*** Other agricultural activities practiced by the agro-pastoralists

### *Climate Data from the Study Area*

Past climatic date collected from the area covered a period of 50 years, from 1960 to 2009 (Fig. 2). The data revealed that there has been temperature variability as well as a general increase in the average annual temperatures. The average annual temperature were 18.755, 19.10, 19.61, 20.08 and 19.77 °C for the decades ending in 1969, 1979, 1989, 1999 and 2009 respectively (Fig. 3). This shows an increase of 1.0°C between 1960 and 2009.

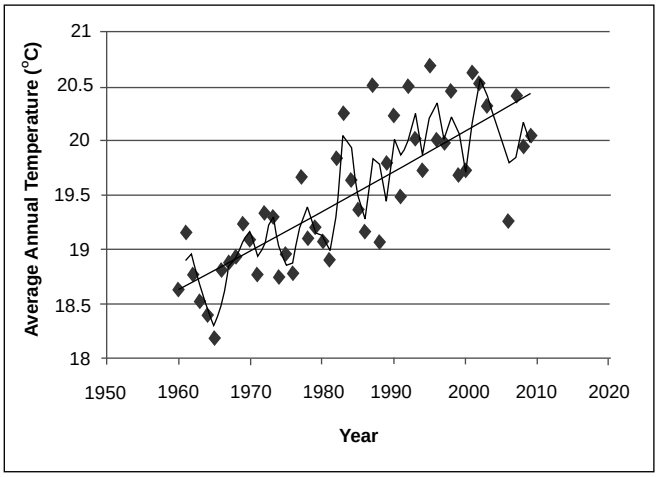


***Figure 2:*** Change in mean of average annual temperatures (°C) in Choma district

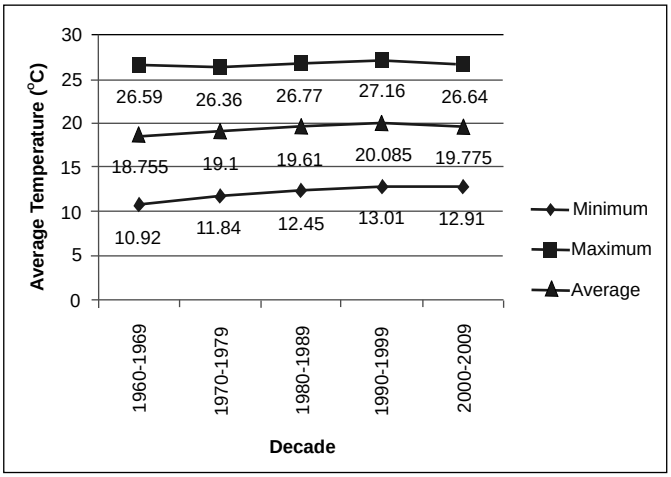


***Figure 3:*** Decadal average temperature (°C) in Choma district

The rainfall data revealed that there has been an increase of variability in the amount of annual rainfall received from 1973 to 2009 (Fig. 4). There is less variability shown from 1951 to 1972. These data indicate that the frequency of floods and droughts have increased from 1973 to 2009 compared to the period 1951 to 1972. Decadal rainfall averages show an increase from 810.13 mm to 851.75 mm in the two decades from 1960 to 1979 and then reduced to 775.28 mm in 1989 (Fig. 5). There was further reduction to 714.49mm to 1999. In the decade from 2000 to 2009 there was an increase to 813.59mm. This shows that there have been floods in certain years and some droughts in other years. The trend line also shows that there has been a general decrease in rainfall over the whole period of six decades, (Fig. 4).

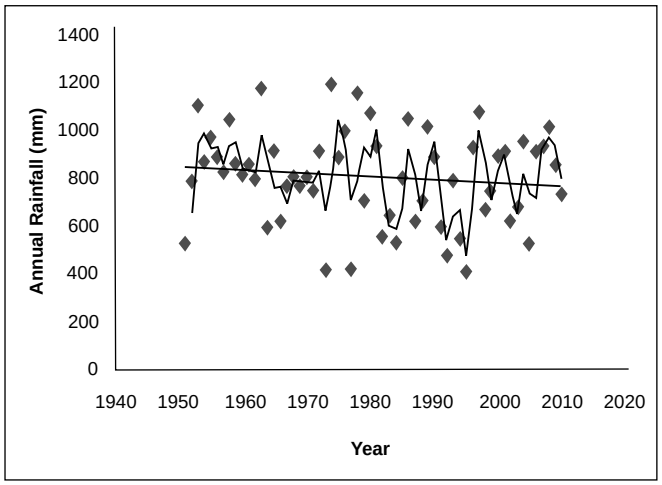


***Figure 4:*** Variations in annual rainfall (mm) in Choma district

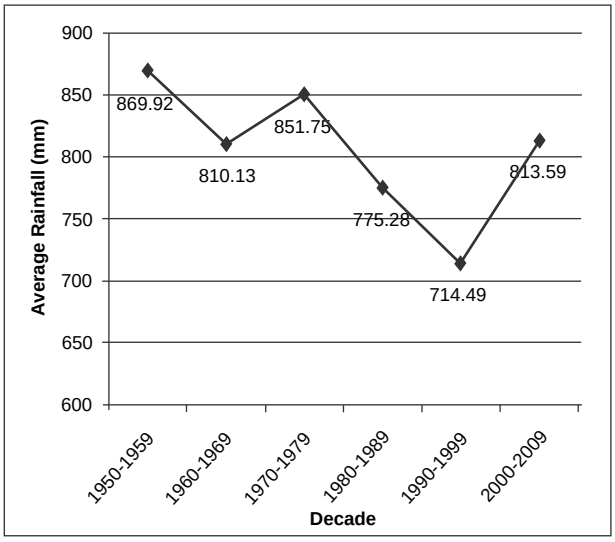


***Figure 5:*** Decadal average annual rainfall in Choma district

*Responses to Climate Change and Climate Change Indicators.*

As shown in figure 6, 98.33% of the respondents indicated that there has been climate change over the past 30 years. Most of the respondents (85.00%) used the increase in rainfall as the indicator for climate change compared to decrease in rainfall (18.33), late onset of rains (5.00%), the weather becoming hotter (1.67%) and the weather becoming colder (3.33%) (Fig.7). The highest response for the increase in rainfall could have been due to the fact that the people had experienced unprecedented floods the rainy season just before the survey was conducted.

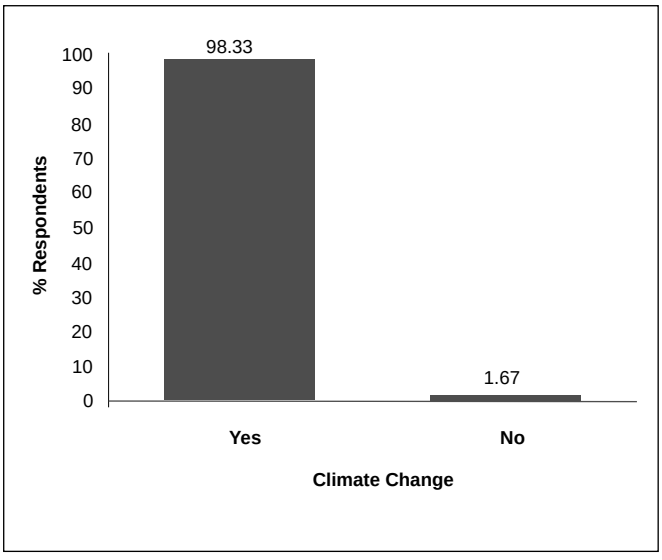


***Figure 6:*** Evaluation of climate change in Choma district over the past 30 years

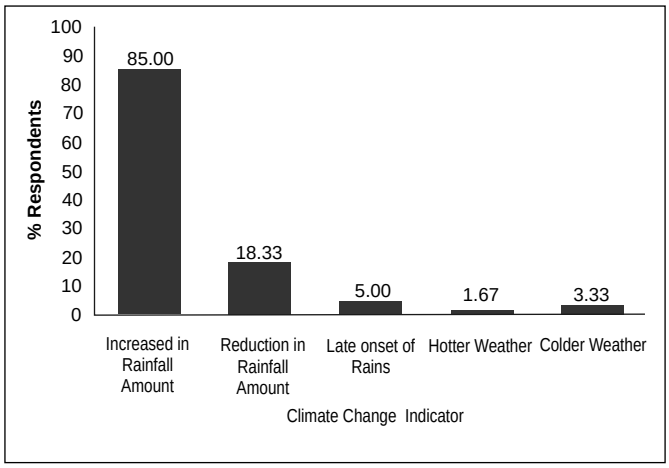


***Figure 7:*** *Comparisons of climate change indicators in Choma district*

*Livelihood Adaptive Strategies in Extreme Weather Conditions*

Table 1 shows that the major livelihood practices for the agro-pastoralists in times of extreme weather conditions are livestock sales and engaging in non agricultural activities. The main non-agricultural activities were charcoal burning and sale of firewood, trading, working for others and carpentry.

Most respondents (53.15)% indicated that charcoal burning, sale of fire wood, carpentry, carving and sale of thatching grass were the most important non-agricultural livelihood strategy during extreme weather conditions (Table 1). The least practiced activities (1.69% ) were collection of wild fruits and fishing.

***Table 1:*** Agricultural and Non-agricultural livelihood strategies of pastoralists during extreme weather conditions.

| Livelihood practice | Respondents % | Ranking |
|---|---|---|
| **Agricultural** | | |
| Sale of Livestock | 93.33 | 1 |
| Sale of Crops | 31.67 | 2 |
| Vegetable Growing | 23.33 | 3 |
| Sale of Citrus Seedlings | 3.33 | 4 |
| **Non- agricultural** | | |
| Products from Forest (Charcoal burning, sale of firewood Carpentry/Carving, Sale of Thatching Grass) | 53.15 | 1 |
| Trading | 30.51 | 2 |
| Working for Others | 13.56 | 3 |
| Bee Keeping | 6.78 | 4 |
| Bricklaying | 3.39 | 5 |
| Knitting | 3.39 | 5 |
| Wild fruit collection | 1.69 | 6 |
| Fishing | 1.69 | 6 |

## DISCUSSION

With rain-fed agriculture being the main source of livelihood for the local people this study shows the importance of documenting the impact of climate change on their livelihood. This is because climate change has direct effect on rain-fed agriculture. The temperature data which showed an increase of 1.0 °C. between 1960 and 2009 is even slightly higher than the empirical evidence that shows a warming of approximately 0.7°C over most of Africa during the 20th Century[8]. According to Intergovernmental Panel on Climate Change (IPCC)[5] a 3 °C temperature increase could lead to 0.4 to 1.8 billion more people at risk of water stress. The population at risk due to increased water stress in Africa is projected to be between 75-250 million people by 2020 and 350-600 million by 2050. This increase in average temperatures would cause a reduction in water availability which will impact negatively on livelihoods of the people since they depend on rain-fed agriculture. Increase in temperature can also cause decrease in livestock productivity directly and indirectly through changes in the availability of feed and fodder. There is also increase incidence of pest attacks and manifestation of vector and vector borne disease.

The rainfall data which showed that there has been an increase in frequency of floods and droughts between 1973 and 2009 compared to the period between 1951 and 1973 reveals the reality that climate change will have on the livelihoods of the people. The trend line which shows that there has been a general decrease in rainfall over the whole period of six decades, (Fig. 4) entails that there is going to be more stress to rain-fed agriculture. Hume et al[9] found a decrease in precipitation by about $2.4 \pm 1.3$ per decade in tropical rainforest of Africa since the mid 1970s. If this trend continues, there is going to be an increase in water stress as the demand from water increases due to increasing human and livestock population. Reduction of water will lead to loss of food production capacity due to decreasing yields and hence the threat to food security. Intergovernmental Panel on Climate Change (IPCC) (5) estimates that by the 2080s, parts of arid and semi-arid lands in Africa will likely to increase by 5-8%. It is therefore importance to ensure that climate change reversal measures are put in place to avoid acceleration of this problem. These include reduction in deforestation and burning of grasslands, fossil fuels and other wastes. These measures reduces the amount of carbon dioxide one of the green house gases which is emitted into the atmosphere and causes climate change. Feeding the ruminant high quality pastures is also important because if the ruminants are fed poor pastures they produce more methane which is one of the green house gases that cause climate change. Experiments have demonstrated that with animals on high quality pasture or balanced rations producing less methane (270 – 350 g methane/cow/day) than those on poor quality pasture or feeds (370 - 450 g methane/cow/day), linking productivity to emission rates (9)

The revelation that the harvest of forest and forest products are important in times of extreme weather conditions for the survival of the people suggests that there is change in

livelihood strategies as climate changes. Charcoal burning, carpentry, curving, selling of firewood, sale of thatching grass and collecting of wild products are activities that will have a negative impact on the forest with increased climatic variability. There more extreme weather conditions will be the more pressure will be put on the forest which could lead to serious deforestation and land degradation. There is therefore need to encourage livelihood strategies that do not impact directly on the forest and encourage re-planting of the indigenous trees to ensure sustainable use of the forest. Coping strategies such as bee keeping and trading do not impact negatively on the forest. This will help to mitigate the negative effects of climate variability and climate change.

## CONCLUSIONS

Farmers have the right perceptions concerning climate variability and extreme weather conditions and as seen in the way the carry out their faming activities and adapt during these extreme conditions.

There is need to encourage alternative livelihood strategies to climate variability so as to reduce the negative impact of the forest and forest products to avoid deforestation. This will ensure sustainable utilization of the natural resources for the long term benefits of the farmers.

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