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**Investigating the Impacts of Climate Change
Vulnerability on Livelihoods and the Environment;**

The Case of Luangwa District, Zambia.

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Disclaimer:

This document represents part of the author's study programme while at the Institute of Social Studies. The views stated therein are those of the author and not necessarily those of the Institute.

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List of Acronyms

C.F	Conservation Farming
CFZ	Child Fund Zambia
CPR	Common Property Resource
CRB	Community Resource Board
DACO	District Agricultural Coordinator
DC	District commissioner
DFO	District Forestry Officer
FDG	Focus Group Discussion
FTC	Farmers Training Centre
GEF	Global Environmental Facility
GMA	Game Management Area
IPCC	Intergovernmental Panel on Climate Change
ISS	Institute of Social Studies
NAPA	National Adaptation Program Action
NGO	Non-Governmental Organisation
ODK	Open Data Kit
PES	Payment for Ecosystem Services
UNDP	United Nations Development Programme
ZAWA	Zambia Wildlife Authority

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Abstract

In Zambia rain fed subsistence agriculture is under serious threat from climate change. In response to the adverse effects of climate change and vulnerability, rural communities tend to diversify their livelihoods, supplementing agriculture with natural resource extraction. Their extraction methods are often times unguided and unsustainable hence these activities have detrimental residual effects on the environment which in-turn exacerbate the problems that led to such practices. This study was aimed at assessing how climate change vulnerability leads to biodiversity loss due to unsustainable livelihood diversification in Luangwa district of Zambia. The study used various qualitative research methods of data collection such as household farmer survey, focus group discussions, fishermen and wildlife camp officers' interviews, key informant interviews with government heads of departments, and the analysis of secondary meteorological data to address the research objective.

The study established that climate change vulnerability and unsustainable, climate induced livelihood diversification leads to serious environmental threats that can lead to biodiversity loss. Some of the most serious environmental threats that have emerged in Luangwa district due to climate change include; (i) deforestation due to unsustainable charcoal production, this has led to wildlife habitat fragmentation, reduced forest cover undermining the greenhouse gas sequestration potential, and increased anthropogenic climate change, (ii) depletion of fish stocks due to overfishing in both the Zambezi river and the Luangwa river (iii) high levels of wildlife poaching. As vulnerability is highly associated with adaptive capacity, it has been established that once people become vulnerable, their social networks and structures, and their resilience and economic capacity to deal with climate associated problems are weakened, and they usually move towards destitution. This paper advocates that climate change adaptation practices for rural communities be developed to guide and assist sustainable natural resource management through this climate critical period.

Relevance to Development Studies

The impact of climate change on the resources and livelihoods of most poor people in developing countries cannot be overemphasised. Agriculture, the main livelihood activity for most rural people, has become very vulnerable to effects of climate change. Lack of alternative livelihood options has forced them to adapt in unsustainable ways by resorting to overexploitation of natural resources. Despite so many studies being carried out previously on climate change adaptation, very few have focused on how climate induced human activities affect natural resources. Often the

debates about these issues have occurred in isolation, and those aligned with agrarian issues tend to focus on climate change, agriculture, and livelihood change, and rarely on how climate induced livelihoods affect the environment. This research is located in the debate surrounding agrarian and environmental issues particularly at ISS and seeks to show that climate change, livelihoods and environmental issues influence each other and that they should not be studied, debated and treated separately.

Keywords

Climate Change, Vulnerability, Adaptation, Livelihood, Biodiversity, Political Ecology, Luangwa, Zambia.

Chapter 1 : Introduction

1.1 Setting the Scene:

“.....people in rural areas are most vulnerable to climate change, because it directly affects the resources in the ecosystem on which their lives depend. Countries with newly developed economy will be seriously hit, economically and socially, within the next few decades by natural disasters such as floods, drought and storms, which have been increasing in numbers and severity. Climate change will affect disaster risks in two ways, firstly through the likely increase in weather and climate hazards and second through increases in vulnerability of communities to natural hazards, particularly through ecosystem degradation, reduced water and food availability and changes in livelihoods ” (Shaw et al. 2010: 1 - 2).

Climate change is one of the major challenges threatening human society in the 21st Century (Eriksen and O'brien 2007, Shaw et al. 2010). The consistency between observed and modelled changes in several studies and the spatial agreement between regional warming and steady impacts at global scale on the environment, physical and biological process provide mounting evidence that attest the warming of the world and that the climate is changing (Parry et al. 2007). Climate change is defined as a long term continuous change in average weather conditions or the range of weather; effects include physical responses such as change in surface temperatures, extreme weather conditions such as droughts and floods, storms, sea level rise among others. These effects have adverse effects and are relevant over longer timescale, usually, decades or centuries (Stocker et al. 2013, Krishnamurthy et al. 2015). For instance, overall decline in rainfall may result in shift of agricultural land or livelihood activities. However, the current concern about climate change is about the rate of change in weather conditions, how fast it is occurring and the implication for vulnerable communities (Krishnamurthy et al. 2015).

While previous reports from the Intergovernmental Panel on Climate Change (IPCC) warned that climate change will have profound impact on human and ecosystem during the coming decades due to variations in temperature and rainfall, the fifth and most recent IPCC report goes further, warning that climate hazards will also exacerbate other stresses, often with negative outcomes for livelihoods especially for people living in poverty (Parry et al. 2007, Stocker et al. 2013). While it has great adverse effects on human wellbeing, climate change also affects the livelihoods of poor people, especially weather dependent activities, often times leading to shifts in rural livelihoods, such as from agriculture to urban wage labour in , migration, and natural resources dependency, among others (Shaw et al. 2010: 2). The end result is that climate change propagates a paradigm

of dynamic and differentiated livelihood trends based on the capacity to respond to vulnerability and geographical location.

As explained by Saw et al. (2010: 3 - 4), climate change will affect all countries, but people in the poorest countries and poor peoples in richer countries, those with little or no means to cope, are more likely to suffer the most because they depend on climate sensitive sectors such as agriculture. In the case of many developing countries like Zambia, agriculture is the main source of livelihood for majority of the population. Agriculture remains an important economic sector for Zambia, contributing 20% to Gross Domestic Product and employment to 85% of the national population, of which 95% is located in rural areas (Mucavele 2013: 13). However, this sector is highly vulnerable to climate change effects because of its reliance on rain fed agriculture. Over the past decades, scientific observed meteorological data clearly indicates that the country is experiencing a variety of climatic hazards, which include intense rainfall, floods, seasonal droughts, multi-year droughts, dry spells and heat waves among others. For instance, observed temperatures from 1960 to 2006 indicate summer temperatures increasing at the rate of about 1.3°C per decade (McSweeney et al. 2010). The highest increase in temperature has been recorded during the hot wet season, between November and December as compared to other periods across all ecological Zones.

The major farming season in Zambia is rain fed with most of the agricultural activities depending on rain water and the season stretches from November to April. The minor insignificant cropping season runs from June to September with little yields. Major crops grown in Zambia include; Maize, Sorghum, Millet, Rice (Paddy), Wheat, Cassava, Groundnuts, Sunflower, Soya Beans, Mixed Beans, and Tobacco. Most of these are summer subsistence crops which entirely depend on rains, with the exception of Wheat which is winter crop grown mostly by large scale farmers using irrigation (Jain 2007: 5)

There have been anomalies in the observed rainfall data since around 1970s with the Southern Zone (I) experiencing more severe droughts than the other two region. Annual rainfall has decreased by an average of 1.9 mm per month per decade (McSweeney et al. 2010). Since Zambian agriculture largely depends on rainfall, crop production has been adversely impacted by extreme climate change events manifesting through long-term changes in rainfall pattern and distribution. In the past two decades, Zambia has experienced its worst recorded droughts and floods, including repeated significant rainfall deficits at critical stages of crop growth and grain formation, leading to serious shortfalls in crop production.

The fifth report of the Intergovernmental Panel for Climate Change (IPCC) warns that Climate Change will result in reduced rainfall with high frequency of droughts and shifts in rainfall timing

in Southern Africa and this will result in alteration of livelihoods both in urban and rural areas, with severe impacts on rural poor communities (Stocker et al. 2013). Projections emphasize the complexity and heterogeneity of future climate impacts including the emergence of winners and losers in close geographic proximity. Adaptation efforts of the poor are expected to interact with multiple stressors mostly, social vulnerability, low adaptation capacity and subsistence constraints under chronic poverty, weak institutional support, population increase, natural resource dependence, ethnic conflicts, and political instability . It is also projected that because agricultural activities will be adversely affected, Zambia's poverty head count would increase by 650,000 under a worse 10 years rainfall sequence (Stocker et al. 2013: 810). The weather changes are expected to continue to negatively affect agricultural production across the continent with small scale farmers being more vulnerable (Parry et al. 2007).

This research was conducted in Luangwa District which lies in Agro-Ecological Zone I of Zambia. It is based on the notion that climate change will force livelihood diversification among the rural poor, involving a shift from primarily farming to increasing engagement in natural resource extractive practices, and leading to biodiversity loss (Stocker et al. 2013, Chidumayo and Gumbo 2013). Although not documented, it has been reported and observed over the past years that the people of Luangwa district are increasingly unable to produce food crops to feed their families. During some seasons (1990/1991, 2010/2011 and 2014/2015), crops dry out before reaching physiological maturity and before grain formation. Small-scale livestock is adversely affected due to less water availability and insufficient pasture as a result of severe droughts affecting the district (Kaminsa 2008). Due to this vulnerability, farmers have resorted to unsustainable extraction, use and dependence on the natural resources around them, creating environmental degradation. Three major environmental problems have emerged slowly but very apparent now; Deforestation and habitat fragmentation as more people have reshaped their livelihood activities from farming to fuel charcoal production (Kusena 2009: 9); Depletion of fish resources as a result of overfishing from both the Zambezi and Luangwa Rivers (these two major rivers of Zambia join in this District before entering Mozambique) and; High rates of poaching (confirmed by this research) as a response to low crop yields.

This research was aimed at studying why the people of Luangwa are increasingly shifting away from agricultural based livelihoods in favour of more natural resource extraction and dependence practices over recent years, and whether this shift has been a response to climate change. To understand this, the study assessed various indicators and occurrences of major climatic events and their impacts on livelihoods, (which together represent empirical evidence of climate change) and how people were adapting to these risks.

1.2 Research Question

It is against the above background that this research was undertaken to determine the answers behind the following main research question:

How has climate change vulnerability in Luangwa district reshaped peoples' livelihoods activities and what are the impacts of the climate induced livelihood activities on the environment?

Based on the main arguments of this research, the main research question is broken into three sub questions that were used to guide the process of data collection. The first question was why the people of Luangwa district are increasingly shifting away from farming, and in favour of natural resource extractive practices. The second question attempted to clarify the first, asking whether these people are completely changing livelihoods or trying to diversify. Thirdly the research also sought to establish whether climate change vulnerability is responsible for reshaping these peoples' livelihood as a way of coping with the climate risk. Finally the study postulated reasons why the Luangwa people are unable to sustainably adapt to these climate change hazards.

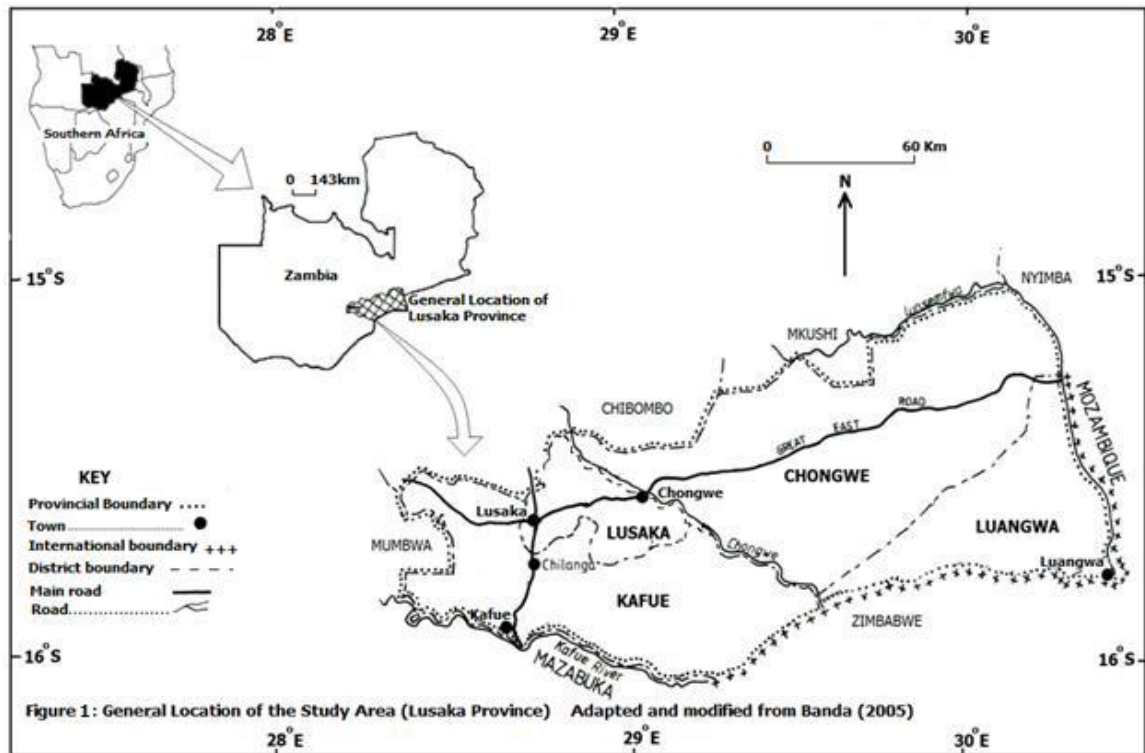
1.3 Study Area

This research was carried out in Luangwa district of Zambia, formerly called Feira, the peripheral town of Lusaka province located on the eastern part of the province. Situated about 350km from Lusaka city, the district is also located at the confluence of the Luangwa and Zambezi rivers, and borders Chongwe district on the west, Mozambique to the east, and Zimbabwe to the south. The recorded history of the district dates back to the 17th Century when a group of Portuguese colonialist from Goa established a trading centre at Feira and Zumbo (in Mozambique). The first township was established in 1902 (Kaminsa 2008: 6).

Luangwa district is also part of the Lower Zambezi National Park (about 28km south west) and the Rufunsa Game Management area, making the area one of Africa's prime wildlife sanctuaries with a great variety and concentration of game and birdlife. The countryside is spectacular in its ragged beauty with thick vegetation near the Zambezi and Luangwa rivers and their numerous tributaries (Kaminsa 2008: 6). The population of the district is mainly concentrated along the Zambezi and Luangwa rivers, with the Luangwa river banks which lies along the main road being highly populated than the rest of the district. According to the 2010 census of population and housing, (Zambia 2015: 27 - 29) Luangwa district is sparsely populated with the total population of 24,304 people, a population density of 7 people per square kilometre, and an annual population growth

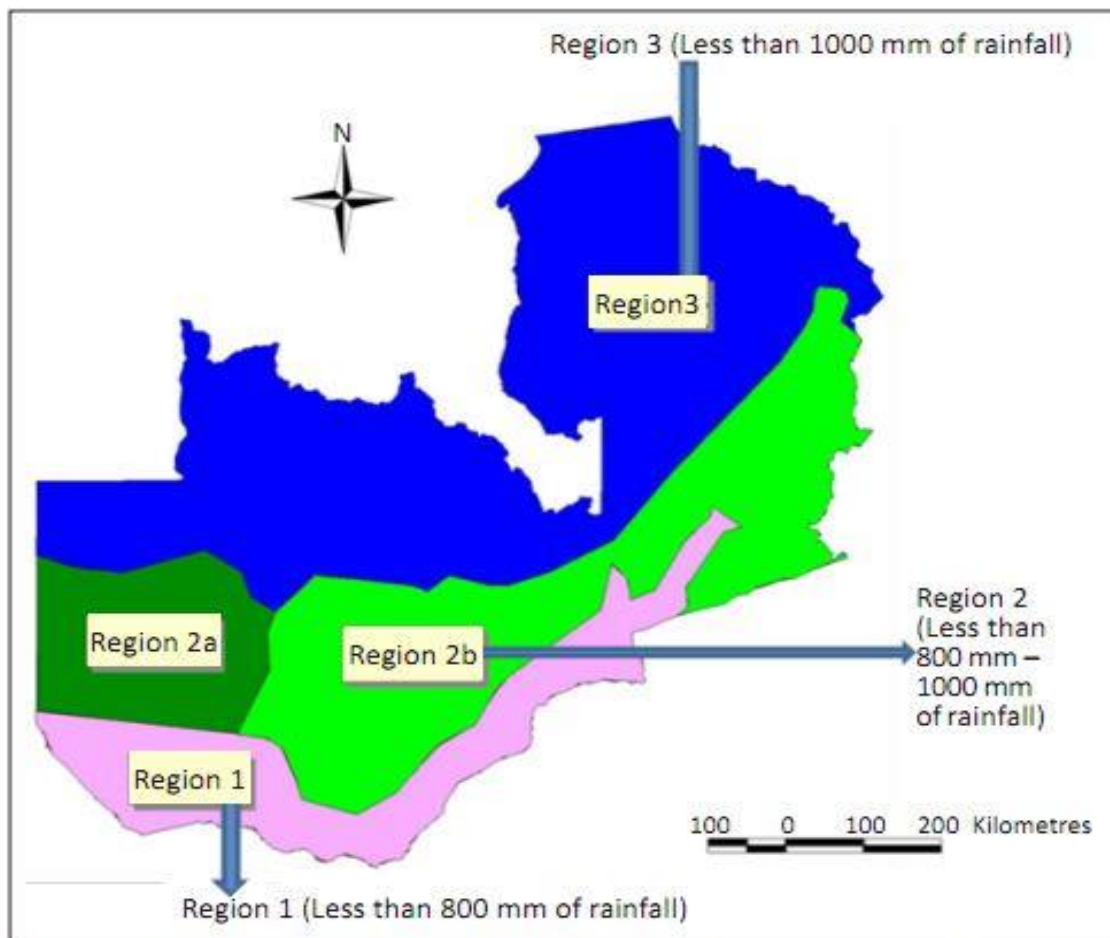
rate of 2.5%. Traditionally, the district is divided into areas led by two chiefs (senior chief Muburma and chief Mphuka) who have jurisdictional authority over all civic and traditional affairs within their territorial boundaries. The maps below show the location of Luangwa district, map 01 shows the location of Zambia on the southern African map and Lusaka province where Luangwa district falls. Map 02 shows the location of villages where the study was conducted and the rivers in Luangwa district with the neighbouring countries.

Map 1: The location of Zambia and Luangwa within southern Africa



Source: (Muchanga 2012: 82)

Map 3: Zambia's Agro ecological Zones



Region I, cover the Zambezi and Luangwa valleys (less than 800 mm); Region II, Covers the central, western and eastern parts of the Country (800 mm – 1000 mm); Region III, covers the northern parts of the country (above 1000 mm).

FIGURE 3: Map of Zambia showing the three agro-ecological zones.

Source: (Dautu et al. 2012: 4)

1.4 Research Methodology, Data Collection, and Analysis

To understand the different dimensions of the climate change vulnerability, livelihood practices and biodiversity loss in Luangwa district, the study employed various qualitative research methods for triangulation and validation (Gilbert 2008: 128). The research used individual farmer survey and secondary meteorological data. Additional data was collected through farmer focus group discussion (FGD's), fishermen and wildlife camp officer interviews, and semi-structured interviews with key informants, mostly government officers. Transects walks allowed the researcher to confirm livelihood practices and verify environmental degradation against responses given during interviews and FGDs. Using case study techniques, the study established histories and timeline of events relating to farming livelihoods, rainfall patterns and occurrences of pests and diseases. The

study employed, a technique of mixed qualitative methods called expansion, an approach where researchers broaden and deepen their inquiry by using different methods to explore a large number of questions with a range of stakeholders (Gilbert 2008: 129). For instance, government department heads were interviewed to understand if and how certain governmental policies might limit rural peoples' engagement with sustainable/non-extractive livelihood options. This approach allowed a broader understanding among the range of stakeholders than would a single method with only one group of respondents.

During the analysis, all qualitative data was categorized into major themes and summarized. The collection and analysis of the individual interviews for farmers, wildlife camp officers and fishermen was simplified by the use of ODK¹ software that uploaded all survey questionnaires to an android tablet, which was later extracted in pre-coded excel format. This data was later analysed in excel to produce summaries in graphs and frequencies. Rainfall data was standardized to get anomalies in order to establish annual variability and trends. The study combined the use of primary data, mostly collected from the research interviews, and secondary data from government records and academic literature review. Below are the detailed explanations about the data sources;

1.4.1 Secondary data

Most of the secondary data for this study comes from academic literature review articles, and different published resources. Much of the reviewed resources relate to climate variability in Zambia and its effects on livelihoods. This research also used secondary data from government records, including rainfall records, farmers' registers, crop yields, poaching records, fishing records and forestry management plans, the results of which are presented in sections that follow.

1.4.2 Primary data

A three week field visit to Luangwa district was undertaken from 23rd July 2017 to 11th August 2017, to collect the primary data for this study. This involved conducting the semi-structured interviews with heads of the departments of Agriculture, Forestry, Zambia Wildlife Authority (ZAWA), and Fisheries, as well as the district commissioner. Further interviews were held with 25

¹ ODK – Open Data Kit is a free and open source set of tool which helps organizations to collect, author and manage mobile data collection. Designed to be used individually or by organizations, ODK provides an out of box solution to many organizations today in developing countries to build data collection forms or survey, to collect the data on a mobile device and send it to a server and to aggregate the collected data on a server and extract it in a useful format (Hartung et al. 2010)

farmers, 20 fishermen, 7 ZAWA camp officers, and 3 focus group discussions with farmers (2 in Mphuka and 1 in Mburuma). Except for government department heads, all the other categories of respondents were selected from the two chiefdoms of Luangwa district to allow for a variety of experiences and results. Transect walks were also undertaken to various agricultural fields, charcoal production areas, and along rivers to witness livelihood practices. While the process of determining the sample size remains a debatable matter, scholars agree that all things being equal, the larger sample size the better. Clarification comes from (Patton 2002), when he stresses that there are no specific rules in qualitative research to determine the right sample size. In this regards, the sample size depends on what one wants to know, the purpose of the inquiry, what ought to be considered credible, and what can be done with the available resources and time. This research followed Patton's recommendation on establishing sample sizes. The table below show the characteristics of farmer respondents interviewed;

Table 1: Farmers interviewed

Chiefdom	Village	Number of farmers interviewed			Household Heads	Spouses	Others
		Total	Male	Female			
Mburuma	Chitoba	1	1	0	1	0	0
	Chikokola	1	1	0	1	0	0
	Kabalo	1	1	0	1	0	0
	Kanaventi	1	1	0	1	0	0
	Mkando	4	3	1	3	1	0
	Mlamba	3	2	1	3	0	0
	Sipopa	3	1	2	3	0	0
	Villi	1	1	0	1	0	0
Total		15	11	4	14	1	0
Mphuka	Fungulani	1	1	0	1	0	0
	Lufasi	2	0	2	0	2	0
	Musiyafumbi	2	1	1	1	1	0
	Mulunda	1	1	0	1	0	0
	Nkalipilana	2	2	0	2	0	0
	Nyaukwindi	2	2	0	2	0	0
Totals		10	7	3	7	3	0
Total Mphuka and Mburuma		25	18	7	21	4	0

From the Government side, key informants included the District Agricultural Coordinator, the District Forestry Officer, and the Senior Warden from ZAWA. Considerations in the selection of key informants included the relationship between their department work, the focus of the study, and the length of time they have lived and worked in the district. These officers were interviewed from their offices using semi-structured interviews. Semi-structured interviews allowed the researcher to have deeper conversations and understanding of issues relating to how farming, poaching and forest destruction have changed over the past years and what the interviewee attribute these changes to.

Individual farmer interviews were held at the homes of 25 farmers. The main purpose of these interviews was to get diverse views of farming related to trends in crop yields, changes in rainfall and weather patterns, and the effects of these changes in their livelihoods. Interviews were mostly open-ended and questions were structured along key research themes and questions. While attempts were made to interview a diversity of farmers in terms of scale and class (such as commercial farmers), to gain a wider array of perceptions and experiences with climate change, an absence of large-scale farmers in the district made this impossible, and interviewed farmers generally possessed similar characteristics of small scale, subsistence farmers. There was also a deliberate attempt to understand the experience of female headed households, and to this end 3 female headed household heads and 4 female spouses were interviewed.

Another component of primary data collection involved farmer focus group discussions (FGD's). These were held at central places to attract participants from all parts of the chiefdoms. In Mphuka, FGD's were held at Nyaukwindi village (with 17 participants including 8 females and 9 males) and at Kakaro area with 22 participants from three large villages (including 12 females and 10 males). In Mburuma the FGD was held at Mkando village with 25 participants from 8 villages (including 14 females and 14 males). As explained by Gilbert (2008:228), FGD's enable the researcher to explore in depth a variety of participants' views and experiences about farming and crop yields, rainfall patterns, livelihood change and policies that limit their capacity to adapt to climate change. Purposefully, the selected participants for FGDs includes a cross section of gender, age and length of time in the particular village. The discussions at all three FGD's were first split into separate groups by gender and interviewed separately, while ensuring balanced representation among groups to get their observations on experiences, practices, yields, strategies, challenges and opportunities. The second set of discussions involved both genders together, to get observations on the same aspects. The study employed the gender based separation technique to address cultural barriers since women often have difficulty expressing themselves in the presence of their husbands or village elders.

To develop a thorough understanding of the current poaching trends and what factors are enhancing the current levels, seven ZAWA wildlife officers were visited and interviewed in their camps. The purpose of the interviews was to: 1) establish whether food production levels have direct links to poaching levels; 2) understand where the poachers are coming from; and 3) to draw trend lines of poaching over the past 10 years. Two officers were interviewed from Kavalamanja wildlife camp, two from Chamitindo wildlife camp, two from Luangwa boma camp and one from Chitope wildlife camp. Similarly, 20 fishermen were interviewed (10 from Mphuka and 10 from Mburuma chiefdom) to understand fishing practices and how many farmers are moving to fishing activities as a result of reduced crop yields. All were males as it was reported that no women were involved in fishing, and these ranged from boys to elderly.

1.4.3 Identification of respondents

This research used non-probability sampling where not everyone has an equal chance of being selected from the sample frame. The study therefore used two methods of judgmental or purposive sampling called Criterion and Snowball methods. Purposive selection is where the researcher deliberately selects a group of people due to knowledge of traits desired for the study. In short you are looking for sources of data that are particularly rich and enlightening in a specific area, which O'leary (2014: 190) calls hand-picking sampling. The Criterion method was used to set a criteria for selecting different group of farmers and fishermen, namely poor and elite, boys and girls, men and women and new migrants. The process of selecting fishermen was similar, with the criteria being the length of fishing history (either long or short). When fishermen were not initially available in Mphuka, snowball sampling or chain sampling was used to create an initial contact with one fisherman who led to the identification of another 3 fishermen.

To commence the study during the visit to Luangwa, on the first day 24th July 2017, contact was made with District department heads in their offices and meetings were scheduled with each one of them in the same week. During initial contact with the District Agricultural Officer on the first day, arrangements were made to use agricultural camp officers (field based staff from department of agriculture) as the first contact in the field for farmer meetings. Five camp officers were informed about the program who later worked with village leaders to identify farmers and fishermen to be interviewed. To meet the wildlife camp officers, the senior warden instructed the Park Ranger to guide the author round all the camps to meet the officers selected by the warden's office. On the second day of the study, a separate meeting was also arranged with the District Commissioner, with whom a very fruitful interview was held.

These actors were selected for their key involvement in farming, fishing, and wildlife monitoring, through extensive experience in the district. To avoid bias, agricultural camp officers were advised to organize farmers from different villages, genders, and financial means within the area.

1.5 Scope and Limitation

Despite the advantage due to the author's knowledge of the area and people, and relationships with government heads, the study was not without challenges. The first limitation was the scheduling time with the department heads, most of whom were very busy with their daily schedules and planned visits from high profile ministerial delegates, so scheduling interviews was difficult. For instance, it took over a week to meet with the district forestry officer who was in the capital, Lusaka, for official duties. Similarly the district fisheries and livestock coordinator was expecting the deputy minister the first week and had scheduled field assignments inspecting deep tanks the following week, making an interview impossible. Similarly, it was difficult to meet all the planned 10 wildlife camp officers because most of them had gone for long patrols. As a result, only 7 were interviewed. The same applied to farmers, among whom only 25 of the 30 planned interviews were possible, as most farmers leave their homes very early in the morning for charcoal making and fishing, and only return in the evenings, as these are livelihoods that support their household needs currently.

The other limitation is that it was difficult to get rainfall data for all the 8 years under review from both the DACO's office and the Zambia Meteorological department. The DACO's office at Kaunga FTC records rainfall readings manually and some of the records for the 2015/2016 and 2016/2017 seasons were missing. Similarly, the Zambia Meteorological department only provided data for seasons starting in 2015/2016 to 2016/2017 because that's the time they started receiving automatic records. Manually entered data previous years, taken from voluntary stations were unavailable as the person in charge of the department was absent.

Another limitation encountered was the difficulty in obtaining annual crop yields for three crops for comparative analysis on the yields because farmers often do not have seed for the second and third crop during certain seasons. The only crop that seems to be grown consistently is maize, while others crops are grown only for few seasons when seed is available. The final significant limitation was the limited secondary data in terms of published resources on this topic, as most of the literature focuses on climate change and agriculture, and very little on livelihood change and resulting impacts on ecosystem, as a result of climate change.

1.6 Overview of Chapters

The rest of this research paper is organized as follows; the second chapter highlights the theoretical frameworks and literature review that guides the analysis and discussions throughout the paper. Chapter three discusses how climate change has manifested in the district over the past 8 years, using empirical data from people's perceptions, as well as climate change variability and trend data (rainfall data), and the impacts of climate change on agriculture over the same period, using the crop yield indicators. Chapter four discusses how climate change vulnerability has influenced the shift in livelihood practices, providing analytical evidence as to how these activity changes are undermining the natural resource base and the ecosystem in Luangwa district. The final chapter, five, provides the concluding remarks.

Chapter 2 : Research Tools: Concepts, Theories and Literature Review

2.1 Vulnerability and Adaptation

Vulnerability is a concept that refers to the likelihood of injury, death, loss, disruption of livelihoods or other harm as result of environmental shocks such as floods, earthquakes or other hazards, or harm resulting from social change such as conflicts or economic restructuring (Eriksen and O'brien 2007: 338). While the concept of vulnerability has become very common in the field of food security, disaster management and mitigation, including climate change, it has range of interpretations and definitions. With regards to climate change, vulnerability focuses on the effects of climate variation and change that pose risk to life, livelihoods, and the resulting well-being of some individual groups of people. To understand climate change vulnerability, Eriksen and O'brien (2007: 339) came up with three dimensions or categories of variables that relate to climate change. These are; (i) the physical risks that result from climate stresses, (ii) the capacity of people exposed to climate change to cope with and adapt to these risks and (iii) the social and environmental processes that exacerbate risks and limit adaptive capacity.

The first dimension of vulnerability relates to the *physical risks* that result from climate stress such as rise in surface temperature, sea level rise, decreased or increased rainfall, soil erosion, and changing weather patterns that include floods and droughts. All these represent much broader risks to poor people than simply a threat to lives as they can contribute to failure to secure or maintain well-being. This dimension of vulnerability allows us to assess and identify different risks that the rural people of Luangwa district are faced with due to climate change and variability and how these risks affect their well-being.

The second dimension of vulnerability relates to the *capacity of people* exposed to climate change to *cope with and adapt to* these risks. Dawson and Spannagle (2008) define climate adaptation as responses, adjustments or actions by humans or natural systems to accommodate and or reduce their vulnerability to impact of climate change. Climate adaptation measures do not reduce climate change but reduce its impacts on well-being. Small communities are the most impacted and the least equipped to cope with the effects of climate variability and climate change. Entitlement and livelihood literatures have focused on people's ability to cope with climate vulnerability in the short-term, and subsequent long-term adjustments (Sen 1981, Scoones 1996). In practice, present

climate change adaptation measures present a useful starting point for assessing future climatic adaptations and their ability to cope with climate variability and extreme events. While geographical location also contributes to the adaptive capacity of the affected people, within the same area, poor people may be more vulnerable to climate change while the rich may not, and urban dwellers may be less vulnerable to climate change due to access to wage labour, than people in rural areas who cannot find wage employment (Eriksen and O'brien 2007, Olsson et al. 2014). This dimension of vulnerability allows us to understand which groups of people are vulnerable to climate change, (the poor, rich, or women-headed households) and how these groups are coping and responding to climate change comparatively.

The third dimension of vulnerability is about the *social and environmental processes that exacerbate risk and limit adaptive capacity*. Vulnerability is generated by multiple processes such as social relations of resource access, political and economic marginalization, loss of employment and weak social networks (Eriksen and O'brien 2007: 339). Since these elements are context specific, vulnerability varies between individuals and social groups as well as over time. Many of the processes that generate vulnerability to climate change are closely associated with *poverty*, as poverty related issues can increase vulnerability to climate stress, and push people into destitution. This dimension of vulnerability provides a good framework for identifying variables that help assess poverty inducing processes, and how poverty hinders the majority rural people from coping with climate change stress. This is a very important tool because it enables us understand how economic and political marginalization, lack of employment, and weak social networks induce poverty and to what level these contribute to climate adaptation failure in Luangwa District.

Sustainable adaptation overlaps with the second dimension of vulnerability, but emphasizes the need to follow planned and sustainable adaptation practices (Eriksen and O'brien 2007: 345). While it is important to take into account the physical impacts of climate change in existing livelihood programs and activities, broader consideration of vulnerability adaptation should take also consider sustainable practices that also contribute to poverty reduction. Climate change risk varies from place to place and between groups, and measures targeted at risks may be very specific to a particular situation. For instance, potential reduction in agricultural productivity due to climate stress can be targeted through measures aimed at changing crop patterns and technologies reinforced by conservation compliance tailored market incentives or even through Payments for Ecosystem Services (PES) (Eriksen and O'brien 2007: 349).

However, one of the main challenges to implement adaptation interventions aimed at reducing risks (e.g. introduction of drought resistant crops, with sustainable adaptation based incentives and PES) is that many such measures require skills, capital or labour that poor households do not have.

Due to a scarcity of programs to promote sustainable adaptation in most rural areas, most poor people end up devising short-term survival strategies through unsustainable natural resource dependence, creating more vulnerability. For example, resorting to charcoal production may look like an immediate solution for rural farmers due to the potential income from selling charcoal, but cutting trees exacerbates local and global climate change by changing precipitation patterns and add more carbon to the atmosphere. Using this concept, we are able to assess whether adaptation measures used by a community use are sustainable, and if the communities are at all aware of the dangers of depending on natural resources extraction.

2.2 Sustainable Livelihoods

According to Chamber and Conway (1992) livelihoods are defined as collaborative or opportunity set of capabilities assets, and activities that are required to make a living. These capabilities depend on access to natural, human, physical, financial, social and cultural capacity or assets. They also depend on the social relations people draw on, to combine, transform and improve on their assets, and more importantly, capabilities deployed and improved by people to act and make lives meaningful. A livelihood is sustainable only if it is resilient to stresses and shocks, and can maintain or enhance its capabilities and assets while not undermining the natural resource base (Chambers and Conway 1992, Scoones 2015).

As highlighted by the fifth IPCC report (Stocker et al. 2013: 798), livelihoods are not limited, and people change livelihoods based on both internal and external stressors. Viable livelihoods transform assets into income, dignity, and capacity to improve conditions. However, vulnerability of weather events and climate variations increasingly threaten and erode basic needs, capabilities and rights, particularly among poor, thus reshaping livelihoods.

A livelihood lens recognizes the flexibility and constraints by which people adopt complex lives and adapt livelihoods in dynamic ways (Stocker et al. 2013: 799). By paying attention to the wider institutional, cultural and policy context, this lens reveals the processes that push people in undesirable directions or towards enhanced wellbeing. Peoples' livelihoods change based on internal and external stresses, and in exploring and understanding these changes Scoones (2015) suggest a typology of three broad directions of livelihood options available to rural people: First are agricultural intensifications that produce more output per unit area, either through capital investments, increased labour, or "extensification" which involves putting more land under cultivations. Secondly are diversifications of income sources, including but not confined to coping strategies. Third,

rural people can migrate, either locally, nationally, or internationally. Exploring these options requires attention to processes and institutions as well as to households.

Scoones (2015) also contends that if we want to understand how livelihoods change we must first focus on livelihood transitions, trajectories or pathways. According to (Dorward 2009), Andrew and colleagues have developed a framework that is important in understanding livelihood change that differentiates between people who are “stepping up” (accumulating assets and improving livelihoods based on their core livelihood activities), “stepping out” (households that are doing well but diversifying to new activities, including some in new locations) and “hanging in” (barely surviving, struggling and failing to accumulate and improve their lot). According to (Scoones 2015) Josphat Mushongah (2009) added “dropping out” for those who are moving towards destitution and exit. This typology though originally developed to explore peoples’ aspirations, can also be usefully linked to an assessment of livelihood dynamics, showing how different people are foregoing a variety of alternative trajectories.

These two typologies of exploring and understanding livelihood change are key steps for this research in understanding the dynamics of livelihoods in Luangwa district. Rather than just relying on hypothetical assumptions that claim that climate change will have negative impacts on the livelihood of the poor people and lead to natural resource dependence, this study critically explores suggestions from these trajectories and pathways in understanding the livelihood change in Luangwa district.

2.3 Political Ecology

To provide critical analysis of the situation this research goes beyond applying the mainstream frameworks of adaptation, vulnerability and livelihood frameworks highlighted above, to further question how we might read contemporary climate change differently through the political ecology lens. This is done not by providing a systemic reconstruction of political ecology, but by seeking to follow its compelling features as an entry point which allows us to understand the narratives and practices through which climate change is both produced and experienced borrowing the works of Marcus Taylor (2014: 3). To do so the study draws together a series of shared concerns about power, representation and the production of the lived environment, that hold political ecology together as an analytical framework.

Firstly, the study takes seriously the notion of political ecology as a field that duly combines the concerns of ecology and political economy in a way that encompasses the constantly changing dialectic between society and land based resources and also between classes and groups within

society itself, which should be a starting point according to Blaikie and Brookfield (1987: 17). The political economy aspect enhances this study by exhuming the underlying practices of the state and its dominant agents which normally lead to accumulation and marginalization of the losers through actions such as taxation, policy, land tenure policy and allocation of resources. This perspective allows us to get to the core of the relational dimension of political ecology in which the couplings of prosperity and marginalization, society and vulnerability, and abundance and degradation are produced and reproduced together through overlapping structures of power across spatial scales (Taylor 2014: 3).

Also rather than just approaching the study from a mainstream perspective which normally believes in *cultural ecology theory*,² using political ecology helps us critically examine power relations involved in managing landscapes and livelihoods. These tasks are usually undertaken with the normative goal of denaturalizing existing socio-environmental orders to better grasp the uneven distribution of gains and risks arising from deeply fused social and ecological processes.

Through such means political ecology speaks directly and vitally to key questions of who has power to adapt, how much power is formed and maintained and at whose potential expense it operates (Taylor 2014). In trying to understand the differentiated impacts of climate change, a political ecology perspective requires us to be more sensitive to multi-scalar power dynamics that construct our lived environments and that actively but in some way reshape the social and physical landscape. This means we consider the thorny relational issue of how the insecurity of some might intimately connect to the relative security of other. Blaikie and Brookefield argued that the failure to engage such questions with curiosity is to overlook how “one person’s degradation is another’s accumulation” (Blaikie et al. 1987: 14). This allows us to critically understand the dynamics of livelihood change in climate critical situation in Luangwa district using political ecology framework. The framework helps as a lens for understanding how different policies have reconstructed the lived environment in Luangwa district as people struggle to cope with climate change hazards. For instance the framework will unveil the impact of policies such as payment of levies for market access, how this undermines peoples’ capacity to adapt , and whether such policies further influence environmental degradation as people try to extract more resources to pay those levies.

² Cultural Ecology assumes that climate change shifts leads to degradation where humans are seen to respond to environmental change by first coping with and then adapting to successive series of external stresses and stimuli; and also believes that solutions and study approaches/frameworks are embedded in vulnerability, adaptation and sustainable approaches (Taylor 2014: 4)

2.4 Brief Literature Review on Climate Change in Zambia.

The literature about Zambia and climate change is still much thinner and mostly focusses on how Zambia's agriculture and food production is struggling in terms of direct impacts of climate change (floods, droughts and pests) on agriculture and food security. The most comprehensive report on climate change in Zambia is the *Zambia's National Adaptation Program of Action* (NAPA) of September 2007 (MTENR 2007). NAPA is a Zambian government formulated in 2007 supported by the Global Environmental Facility (GEF) and the United Nations Development Program (UNDP). It focuses on identifying priority activities the need urgent or immediate need for climate change adaption. This report documents various sectors that have been impacted by climate hazards mostly drought and flooding. The report highlights that because over 70% of the population of Zambia live below poverty line, vulnerable communities do not have sufficient capacity to cope with , or adapt to, the impact of extreme weather events (MTENR 2007: 38). The report further indicate high need to develop adaptation measures to address climate change in Zambia and a minimum number of urgent activities to be implemented to address this are highlighted in the same report to reduce vulnerability and ensure sustainable livelihoods to communities (MTENR 2007: 38).

Other literature on climate change in Zambia include; *An empirical Economic Assessment of impacts of climate change on Agriculture in Zambia 2007* (Jain 2007), by Suman Jain, which focuses on the economic impact of climate change on Agriculture in Zambia. This paper using Ricardian method showcases how agricultural production in Zambia is subject to the uncertainties of weather events where the results show increase in mean temperatures and reduction total seasonal rainfall on a long time scale (Jain 2007: 14). The paper advocates that the Zambian government and all the stakeholders should respond to climate change by formulating and implementing adaptation measures to minimise the negative effects on agriculture which may pose a serious threat.

Another document reviewed is *Climate change in Zambia: impacts and adaptation* (2010) by Couroche Kalantary, which summaries the impact of climate change in Zambia as well as Zambia's adaptation efforts as detailed by the National Adaptation Program for Action (2007). The paper highlights how climate change effects have impacted on agriculture, human health, wildlife and the Zambian economy and goes further to highlight adaptive measures as recommended by NAPA (Kalantary 2010: 93). Like the NAPA 2007, the paper recommends that the Zambian government should come up with some sort of security for its people inform of social safety nets, and should target poverty reduction programs to reduce effects, diseases and death that may result from climate change hazards (Kalantary 2010: 95).

Some of the most recent literature on climate change reviewed included; *Climate trends and farmers' perceptions climate change in Zambia* (2014) by Mulenga Brain and Wineman which details climate change manifestation and trends in Zambia and also discusses impacts and adaptation strategies among small scale farmers in Zambia and perception that people have about climate change. The study showed both overlapping and contradiction results in some climatic parameters analysed between scientific meteorological data and local systems of knowledge based on peoples' perceptions about climate change. However, the paper highlights that through a broader comparison of qualitative and quantitative data, evidence suggest that the study of climate change (and the promotion of adaptation strategies) should not only depend on expert judgement and scientific observations. In some case, peoples' perceptions based on local knowledge system is so valuable as it captures different parameters that cannot be tracked by measuring rainfall and temperature, this offers more contextual interpretations of these climatic parameters (Mulenga et al. 2014: 303)

There are by now many of other reports, documenting climate change in Zambia which were not probably reviewed but from all the literature reviewed, there is none that focuses on how climate change induced livelihoods affect the environment. It is the gap that this research seeks to contribute to.

Chapter 3: Climate change and Vulnerability in Luangwa District; Peoples' perceptions of Climate variability, trends, and impacts on agriculture

3.1 Introduction

This chapter uses primary data to discuss and demonstrate the manifestation of climate change in Luangwa district through empirical evidence collected using various indicators. The main findings that guide the discussion include, the indigenous knowledge systems (IKS) through peoples' perceptions of weather, and climate variability in the district such as shift of the rainy season, number of rainy days, emergence of pests that destroy crops, and the general change in weather patterns based on the indigenous knowledges and justified beliefs. Peoples' perceptions are then complemented with data on the impact of climate change on agriculture using crop yields data and rainfall records. Trends are drawn for crop yields over the past eight years, and compared with trends in rainfall over the same period. The analysis and justification in this discussion is based on the relationship and the synthesis of these indicators guided by the fundamental underpinnings of the theories and analytical frameworks.

3.2 Peoples' perceptions about climate change risks

Vulnerability in the purview of climate change is defined in terms of the capacity of individuals and social groups to respond to (either cope with, recover from, or adapt to) an external stress placed on their livelihood and well-being (Kelly and Adger 2000, Eriksen and O'brien 2007). Kelly and Adger (2000: 1) propose that social economic and institutional constraints that limit peoples' capacity to adapt should also have a central place in vulnerability assessment. According to Sen (1981) availability of resources, and the ability of individuals and the community to access and control those resources, determine how vulnerable they are in difficult situations (Kelly and Adger 2000). This trajectory allows us to identify the underlying causes and processes responsible for making people vulnerable to natural hazards.

Living with natural hazards is no longer a strange thing for Luangwa people. Every rain season brings new of uncertainties, since some traditional knowledge and practices about weather events, which has historically served as critical information are becoming irrelevant (FGD, 26/07/2017, Nyaukwindi Village). This has greatly weakened the community resilience making people susceptible to further upcoming hazards. Notable local perception about climate change include factors

and signs that lead to erratic rainfall, and changes in patterns and distribution that result in drought conditions and sometimes floods. Farmers also associated climate change to factors such as changes in wind directions, anomalies in temperature such as cold spells during the rainy season, clear skies during the rainy season, and occurrences of diseases and pests (interviewee, 27/07/2017, Mkando Village).

People described the climate of their area as characterized by high summer temperatures (especially between October and December) and recurrent floods and drought. Some of the worst events that the district faced include the severe droughts of the 1990/1991 rain season, 2010/2011 season and the 2014/2015 rain season. Similarly, there are notable seasons that have been characterized by severe flooding such as the 2006/2007, 2007/2008, and 2016/2017 seasons which left most households devastated. Pests such as the army worms have been occurring every other season for the past two rain seasons. The effects of droughts, floods, and crop pests often leave rural people of the Luangwa district with low crop yields (yields reduced by 70% compared to most years in the 1990s) that are unable to sustain families (interviewee, 26/07/2017, Nyaukwindi).

Flooding in Luangwa is a result of the district's location, topography, and soils, and the district is flooded by both the Zambezi and Luangwa rivers. The water from the upstream parts of the Luangwa and Zambezi rivers rises the pressure at the confluence of the two rivers causing the water to flow backwards in the Luangwa, bursting the river banks and sending water overland into crop field, homes and other resources (Interviewees, 26/07/ 2017, Kakaro Village). Moreover, soils in the Luangwa district are poorly draining heavy clays typical of Mopani woodlands, that cannot absorb high rainfall events, leading to flash floods especially in people's fields (FGD, 26/07/2017, Kakaro Village).

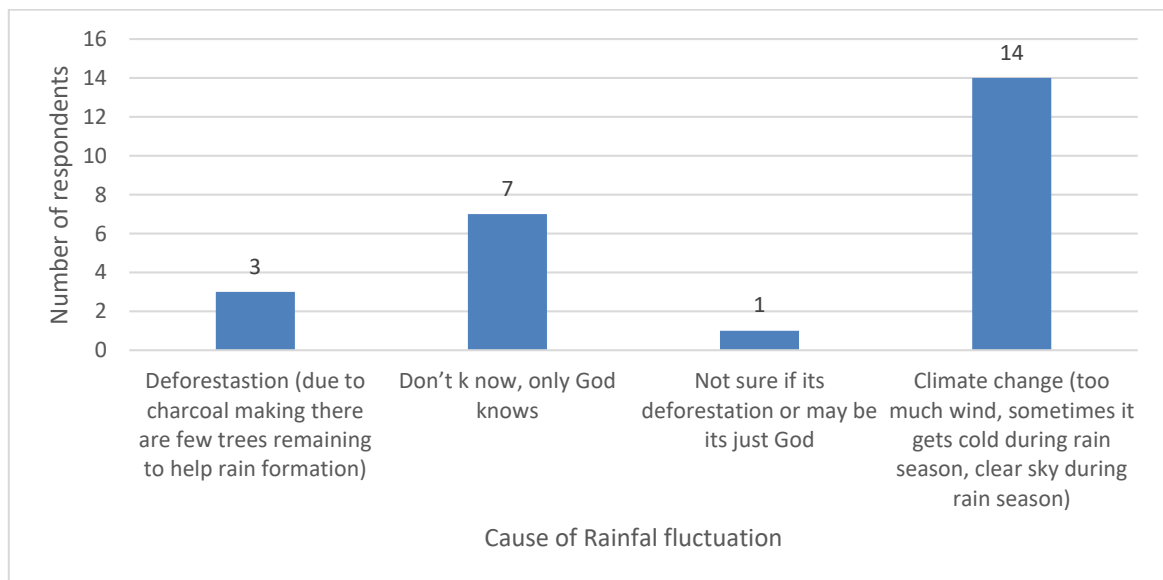
A broad definition of drought is a deficiency of precipitation over a long period of time, usually a season or more, resulting in a water shortage for various activities, groups or environmental sectors. The people of Luangwa experience drought situations in which there is less supply of moisture in the soil than what is required for satisfactory crop growth during the rainy season, which aligns well with Brammer's (1987), definition of drought. The rains usually end at a time when crops are at reproductive stage, leading to crop loss for most of the seasons (DACO's interview, 24/07/2017). This kind of drought also frequently results in shortages of water for drinking and pasture growth for livestock.

Army worms (*Lyphygma frugiperda*) also called corn-bud-worm moths, fall army worm, or grass caterpillar, have been common pests in cereal crops in the USA from around the 1870s. Areas of permanent residence of army worms are associated with cool weather with abundance rainfall, but

outbreaks occur in new places with humid and heavy rainfall after severe droughts (Luginbill 1928: 9). For the past two rain seasons (2015/2016 and 2016/2017) Luangwa district has been highly affected by army worms and this has led to reduction in crop yields by 60%, and unless farmers spray pesticide chemicals, the pests are able to finish up 1 hectare in one week (DACO’s interview, 20/07/2017). Traditionally, recurrent pests such as army worms are associated with changing weather such as the tapering of rainfall and the end of the farming season, resulting in low yields. This notion is also reported by Nkhomwa et al. (2014: 170) in the study of indigenous knowledge system and climate change adaptation strategies in agriculture in Malawi.

People have different perceptions about the cause of rainfall fluctuations and the occurrence of army worms. The majority attribute low rainfall to clear skies during rainy season, getting too cold and too windy during rainy season which they said are signs of climate change (see figure 1);

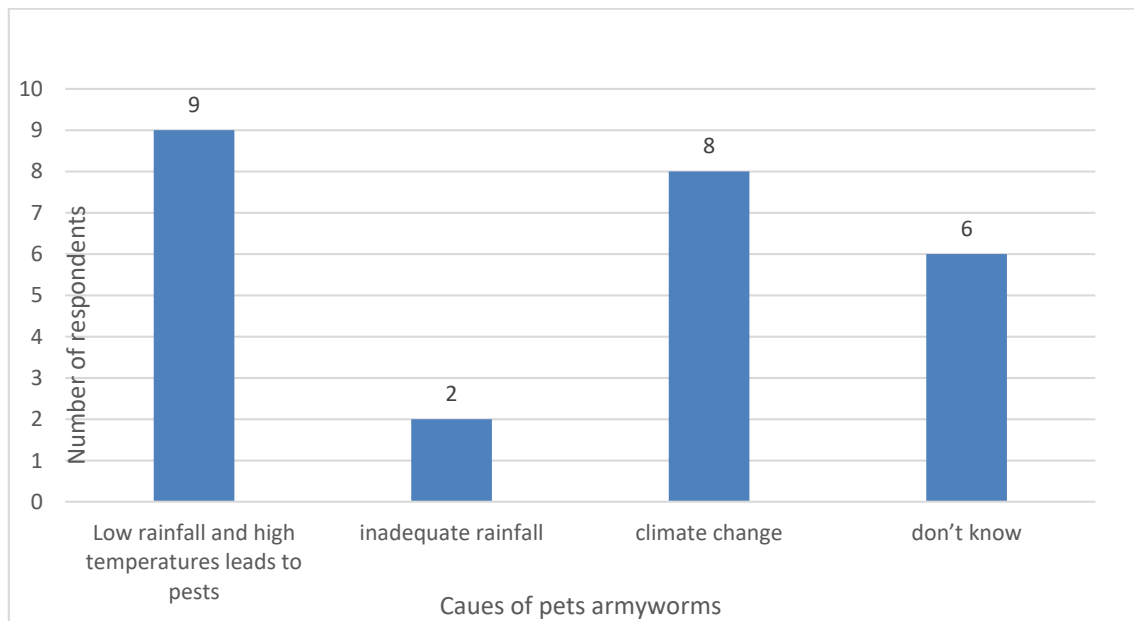
Figure 1: Peoples’ perception about the cause of rainfall fluctuation



Source: (Author’s field data).

Responses about causes of army worms included low rainfall with high temperatures (9 people), low rainfall (2 people), climate change (8 people), and “did not know” (6 people). Of course high temperature, low rainfall are caused by climate change so all answers virtually overlap (see figure 2).

Figure 2: Peoples' perception about cause of Army worms

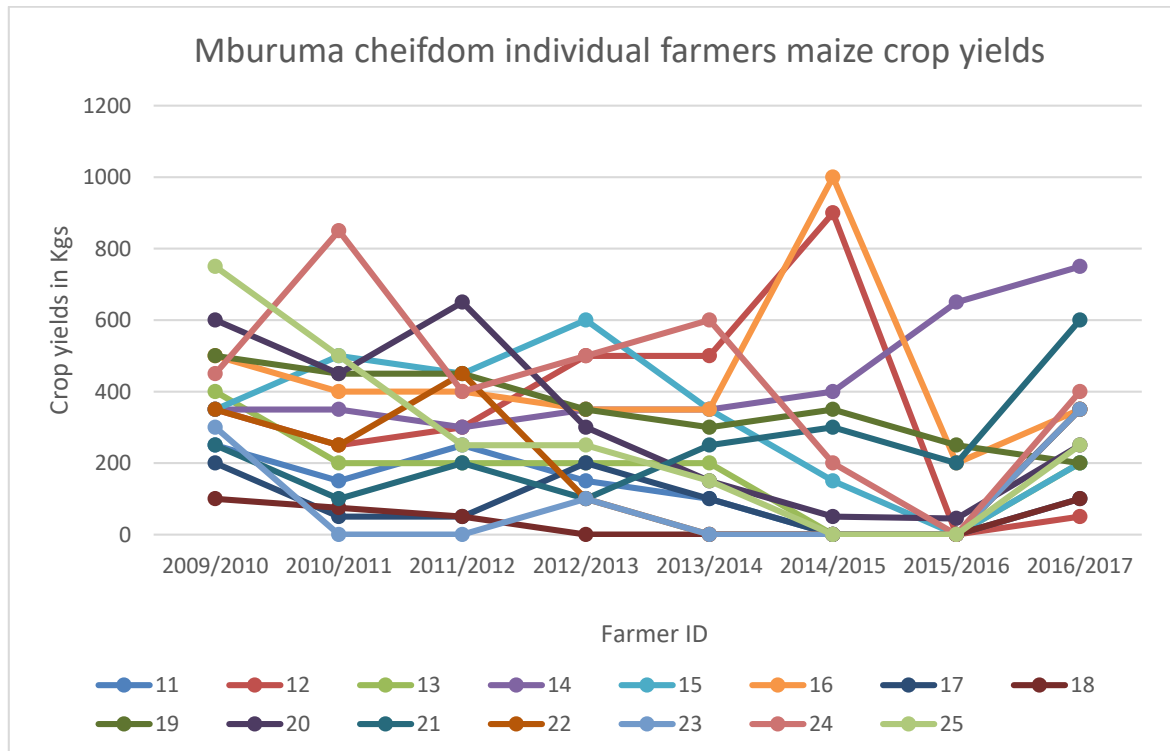


Source: (Author's field data)

3.3 Climate change impacts on agriculture (crop yields and livestock)

This study established that climate change adversely affects agriculture, particularly crop yields, types of crops grown, and farming methods. People responded that there has been a decrease in yields per unit hectare for most food crops, with maize being the most affected (from 600 - 1000kgs in the 1990s, down to 300- 500kgs now). It was also established that, despite its reduced yields per hectare, maize was the only crop that most farmers grow every season, due to lack of seed for other crops like sorghum (very few farmers still have seeds for local varieties, and farmers neither have money to buy hybrid seed, nor is it locally available in the district). This was confirmed by crop yields data for the past 8 years, which confirmed that maize was the only crop for which all farmers had records during the period under review, while farmers did not have seeds for the other two alternative food crops in many seasons, and only grew them when seed was available. As a result the data could not make a good representation of yield trends for crops other than maize.

Figure 3: Maize crop yields Mburuma Chiefdom



Source: (Researcher’s own analysis based on field data for Mburuma Chiefdom)

From the figure 3 above, we can see that the findings for maize do not show consistent trends. It can also be noted that in the 2015/2016 season, yields dropped for all but one farmer (farmer 14). This was the year when armyworms emerged in the district and crops suffered double stress from flooding and pests that severely reduced yields.

When asked about the cause of fluctuations in yields, 21 farmers responded that rainfall has been irregular, resulting in either floods or droughts (interviewee, 26/07/2017, Nyaukwindi Village). One farmer attributed this to the combination of fluctuation in rainfall, pests and crop destruction by wild animals, especially elephants. Interestingly, there was one farmer whose yields have been increasing over the years, which he attributed to the use of early maturing hybrid seed. This is consistent with the last two interviewees who attributed the reduction in their yields to the local variety of seed which takes long to mature and cannot cope with the current reduced amount of rainfall (interviewee, 26/07/2017, Nayukwidi Village). These responses point out the dilemma that while hybrid seed may increase resilience to climate variability, because of cost or availability, most farmers still rely on local seed varieties that require sufficient rainfall (see table 2 below).

Table 2: Causes of variation in crop yields over the past 8 years

Cause of Variation in crop yields	Number of farmers
Inadequate rainfall	21
Inadequate rainfall , pests and wild animals	1
Maize yields increased because of early maturing variety bought	1
Reduction in yields because local varieties of maize can no longer cope with little rainfall received now	2

Source: (Author's field data).

The DACO attributed the variation in farmers' crop yields to extreme adverse weather conditions especially high temperatures and fluctuations in rainfall (DACO's interview, 24/07/2017), he said

“Temperatures have been very high lately especially over the past 10 years and rainfall is very unpredictable in the district. During some seasons we have serious floods while during other seasons we have severe drought, which lasts for more than 15 days. These extreme conditions are highly affecting crop growth and grain formation at reproductive stage because we mostly have droughts during such critical periods”.

He further attributed the variation in crop yields especially for the past two seasons (2015/2016 and 2016/2017) to army worms pests which left 80% of the households without yields. Responses from FGDs revealed that crop yields have not been stable mainly because of army worms and fluctuating rainfall. People explained that they never used to have problems of army worms until the 2015/2016 season, and that they heard from their parents that there was once an outbreak of army worms when they had hot rainy seasons around 1970s. Farmers explained that they were surprised that for two seasons they still had army worm problems. Traditionally, frequent occurrences of pests and different types of termites in crop field are associated with prolonged drought. This correlates with the findings of Nkhomwa et al. (2014: 170) who associated the frequent occurrences of pests with climate change.

People further indicated that climate change has adversely affected livestock production in Luangwa district. About 80% of the people in FGDs, and 95% of household survey respondents, attributed this to diseases such as foot and mouth which was first reported in the country in 1999 and mainly affecting cattle and small ruminants. It was also established that poultry was at high risk of Newcastle diseases which the people associated its occurrence to high temperatures.

Using the vulnerability lens, we are able to identify the major risks through which climate change has manifested in Luangwa district. As already noted, vulnerability in climate change focuses at the effects of climate variation and change that pose risks to life, livelihoods, and the well-being of some groups of people. In this regard, the analysis of the causes of fluctuating crop yields in Luangwa district indicate that weather changes have direct adverse effects on people's livelihoods. The established causes of low and fluctuating crop yields in Luangwa district, namely drought, floods and army worms, represent a broad threat to well-being (Eriksen and O'brien 2007). Because most of the people in the district are dependent on agriculture, these climate hazards have weakened their primary economic activity making community resilience more vulnerable with limited capacity to cope.

When asked to list three main problems affecting crop yields in order of their intensity, 25 farmers explained that their first problem was rainfall fluctuation. They highlighted flooding and droughts being the main challenges associated with rainfall fluctuations. It was also established that pests (the army worms) was the second problem (with 22 respondents) especially over the past two years, while crop damage from wild animals was said to be the third problem, especially in Mphuka chiefdom where there are lots of elephants. The Last, however, is an old problem which has been reduced in areas such as Mphuka, kakaro chiendeende and kavalamanja, where farm fields have been protected by solar powered fences. Asked about the occurrence of the three major problems rainfall fluctuation, drought and flooding and army worm over the past ten years, 15 household survey respondents said that while rainfall fluctuation have occurred at times, they never used to have army worms. On the other hand 10 farmers said that they never used to have any of the mentioned problems in the past (see table 3 below)

Table 3: Frequency of response to the three major problems affecting crop yields

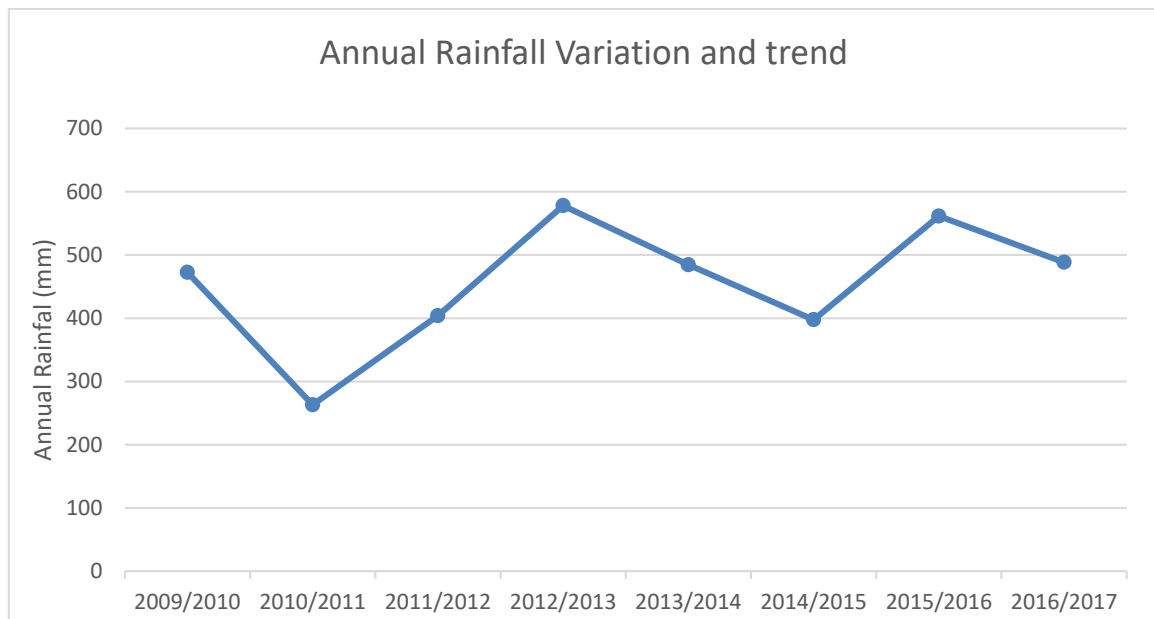
Problem	1st prob- lem	2nd prob- lem	3rd prob- lem
rainfall fluctuations increase and decrease with droughts and floods	25	0	0
Pests army worms	0	22	2
wild animals (elephants and bush pigs)	0	1	7
Livestock	0	0	1
poor local varieties of crops	0	2	0
people do not have food to eat during rain season (so they have to find part time work to buy food instead of working in their won fields)	0	0	2
weed infestation	0	0	1

Source: (Author's field Data)

3.4 Climate change and rainfall variability in Luangwa district

To complement people's perceptions and the impact of climate change on agriculture as a confirmation of climate change manifestation in Luangwa district, rainfall data was collected from Kaunga FTC (a government agricultural research and training centre) and from the Zambia meteorological department for the rain seasons 2009/2010 to 2016/2017. The data was analysed to identify trends and variability, and the results generally show similarities with what people say about climate change and how it has affected agriculture. Figure 4 below shows the variations and trend in rainfall over the past 8 years.

Figure 4: Annual Rainfall Variation and Trend



Source: (Rainfall Data from Kaunga FTC and Zambia Meteorological Department)

This study established similarities between the rainfall figure (4) presented above and crop yields presented earlier in figure 3. Crop yields have been fluctuating with rainfall, the trend is generally the same for most of the seasons except for 2015/2016 when the rainfall went up while most of the farmers' yields went down even to zero. Two reasons attributed to this; (i) this is the season when pest (army worms) first emerged in the district and about 80% of the people lost their crop and (ii) there were too much rains received during the end of January and the beginning of February which resulted in flash floods and crop loss.

Also, household survey and FGDs both indicated that the pattern and distribution of rainfall has changed, with 98% of farmers responding that in the past rains would start by first week November and be well distributed through the months and throughout the district raining up to March, whereas over the past 10 years, the pattern and distribution has greatly changed. Rains now only begin around the second week of December, with very few rains in January. By the mid-February, the rains are usually gone. This is also similar to the data collected from Kaunga FTC, showing that the number of rainy days have reduced and rains are beginning in December, with very insignificant amounts recorded in November (November 2012 recorded 0 mm rainfall, November 2013 was 0 mm, and November 2014 was 29.5 mm, while in the 1990s and years before the average rainfall records were around 45- 55mm in November) rains typically end in February (rainfall data Kaunga FTC collected 07/ 08/2017). Occasional excessive rains such as the 2007/2008 and 2016/2017 season, were also noted, which result in sporadic, severe flooding that impacted crop

production (Interviewee, 26/07/2017, Nyaukwindi Village). For instance the district agricultural coordinator said;

“The rainfall is very unpredictable in Luangwa. Usually there are either floods or droughts. The distribution is not even across the district and over the years the number of rainy days has reduced with more drought at crop reproductive stage, mostly in February” (DACO’s interview, 24/07/2017).

Results from focus group discussion generally indicate that rainfall distribution has changed and the new regime is mainly characterized by a short season, severe flooding and drought during certain seasons, and localized instances of excessive, prolonged rainfall. From these responses it can be concluded that rainfall has become a serious factor undermining peoples’ livelihood activities and farmers believe it highly contributes to their vulnerability. Also from their responses, as much as the people understand that Luangwa lies in the rain shadow area, people believe the situation is worsening, and the distribution and pattern of rainfall have completely changed, which they associate these events with climate change.

From the presentation of the empirical data above, on all the three indicators assessed (namely; peoples’ perception on climate change, climate impact on agriculture, and rainfall variability) the result suggest that agriculture, the main economic livelihood activity of the people in district, has been adversely affected. Natural hazards such as droughts, floods, unpredictable rainfall and pests which are also associated with climate change have repeatedly been mentioned as major risks undermining peoples’ livelihoods. As suggested by Islam et al. (2010: 22), for every community, vulnerability is high if climate risks have a negative effect on the livelihood of the rural people. Similarly, Eriksen and O’Brien (2007) identify three dimensions of vulnerability with regards to climate change that are important in understanding the effects of climate change on people, namely; (i) effects of climate change variation that pose risks to life, livelihoods and wellbeing of people, (ii) the capacity of people exposed to climate change to cope with and adapt to these risks and (iii) social and environmental processes that exacerbate risks and adaptive capacity.

Going by this suggestion, based on the empirical data presented above, risks of climate variation in Luangwa district that are undermining peoples’ livelihoods have been worse compared to 2 decades ago. The study established that floods, drought and pests have been the major risks affecting agriculture. These risks have at the same time undermined peoples’ capacity to adapt, weakened social networks and social relations of resources, and have eventually resulted in economic marginalization. In such a situation, Kelly and Adger (2000), following the Sen (1981) entitlement

approach, argue that climate change effects that result in lack of livelihoods and economic resources generates a process of vulnerability closely associated with poverty, which pushes people into destitution.

3.5 Differentiated Impacts of Climate Change

As we assess the impact of climate change and vulnerability, Eriken and O'Brien (2007: 339) encourage to also focus on how geographical location plays into the variability of impacts on different groups of people. Going by this approach, it has been established that in Luangwa district, entitlements and livelihoods have been adversely affected and vulnerability is associated with poverty, gender, age and geographic location. For instance, people responded that village dwellers are more vulnerable to climate change effects compared to urban dweller because the latter are able to find part time jobs as a way of coping, whereas it is difficult for the farmer to find jobs in the villages. Farmers also responded that female headed households were more vulnerable compared to male headed households as men are able to engage with other coping practices not culturally available to women, like fishing, reed matts making and bricklaying jobs.

The study also established that the elderly are more vulnerable than young people in the community despite the availability of the “social cash transfer” program, a government social program for the elderly. It was generally felt that the program provides insufficient support (K180 or \$21 bi-monthly). Only about 10% of the old aged are benefiting from this program, while the young men are able to engage in manual jobs that demand able bodied person. It was also interesting to note the small difference in vulnerability between the poor and the rich people in villages. People said that for the rich to survive they depend on their businesses (mostly small shops) which also depends on the capacity of the surrounding people to pay for the goods. With most peoples' primary source of livelihood, agriculture, having been adversely affected, business has suffered. For example during the FGD at Nyakwindi village people said:

“We are the same because the rich can no longer do business. For example, Tresea Tembo a local lady during the 2016/2017 rain season ordered maize meal (Zambia’s staple food) to sell but despite that everyone did not have food. No one bought the meal because we all did not have money. She then tried to exchange the meal with charcoal which every household is producing, but she was unable to find market of the charcoal locally at Luangwa township and also failed to take the charcoal to Lusaka where there was market and eventually she just lost” (FGD, 26/07/2017, Nyaukwindi Village).

However, based on the fact that the rich needed the market of the poor people, and that the poor people have lost their livelihoods through climate change, even the rich people are vulnerable and this is creating a new group of which I would call the “new poor”. Only those in formal employment and those living close to the township are somehow better in terms of coping with the climate hazards because they earn income and can provide household needs.

Chapter 4: Linking rural livelihoods with climate change adaptation and effects on the environment in Luangwa district.

4.1 Introduction

Climate change has adversely impacted on agricultural production and as a result of this the people of Luangwa have sought to diversify livelihood activities by combining farming with other non-agricultural based activities as an adaptation strategy. Although there are numerous definitions and application of the term “adaptation” in the climate change literature this study treats adaptation in the context of the human dimension of global change which refers to a process of either a household or community in order for the household or community to better cope with, manage, or adjust to some changing condition, stress, hazard, risk, or opportunity (Smit and Wandel 2006: 283). One of the major focuses of this study is to look at the impacts that adaptation leaves on the environment. However, Shaw (2006: 2) highlights one important aspect of adaptation to climate change that it has potential to substantially reduce many of the adverse impacts and enhance beneficial impacts though neither without costs, nor without leaving residual damage.

Paradoxically, while climate change adaptation has been highly discussed over the past several years through organizational and adaptive responses, little has been focused on individual and community level adaptation, despite the understanding that the worst sufferers of climate change are rural communities who depend on agriculture for their livelihoods. This research suggests that it is important therefore to focus on the impacts of climate change on livelihoods and strengthen the links between vulnerability and adaptation while generally not ignoring the interplay between poverty, livelihood and environment a notion also affirmed by Shaw (2006: 2).

Going by this approach it is concluded that adaptations are manifestations of adaptive capacity and they represent ways of reducing climate change vulnerability. Given that the effects of climate change cover multifaceted dimensions of rural livelihoods, there is an urgent call to understand the broad linkage between vulnerability and adaption measures. It is also important to recall the suggestions by fifth IPCC report (Stocker et al. 2013: 798), that livelihoods are not limited, and people change livelihoods based on both internal and external stressors but important and viable livelihoods transform assets into income, dignity, and agency to improve conditions provided they are capable of alleviating poverty. However, vulnerability to weather events and climate variations increasingly threaten and erode basic needs, capabilities and rights more especially among poor

and vulnerability in turn reshapes their livelihoods. Based on the evidence that climate change has adversely affected the livelihoods of the people in Luangwa district, this chapter discusses the livelihood activities being practiced by the people and how these are linked to climate change adaptation, while taking a critical analysis of how these livelihoods affect the biodiversity.

4.2 Agriculture and climate change adaptation in Luangwa district

In response to climate change impacts on agricultural production, there has been a change in the type of crops, variety grown and farming methods in Luangwa district. Responses from both individual survey and FGDs established that over 90% of the people want to grow drought resistant crops and early maturing varieties. For instance most people complained that;

“The reason why most of us do not have good yields for maize is that we still use local varieties which cannot cope with the low rainfall being received in the district. We want to grow early maturing hybrid seeds but we do not have money to buy the seeds and hence we still use the same local varieties except for a few farmers (only about 10%) who are capable of buying seeds” (FGD, 27/07/2017, Makndo village).

It was also established that about 90% of the people want to grow sorghum which is more drought tolerant compared to Maize. Farmers indicated that maize was an exotic crop which was introduced to the district by the colonial masters and the Zambian government around 1950s. It was from then that the people in Luangwa abandoned growing sorghum as the main crop replacing it with maize, but now that the rainfall is no longer favourable for maize production the majority of farmers are willing to switch back to sorghum (which can withstand high temperatures and requires less water compared to maize) if they have seed. Farmers also explained that the number of people growing sorghum and cassava is increasing despite still facing challenges in planting materials as seeds are not locally available and also due to high cost of hybrids seed in the capital city.

Responses from FGDs and DACO's interviews also indicated that people are changing their farming methods from their conventional maximum till to conservation farming (CF) the method that allows digging permanent planting basins and compost manure application which overtime improve soil fertility, drainage system and water retention capacity (Nolin and von Essen 2005: 3). The basins help to hold water during drought periods enhancing plant survival. About 90% of the farmers indicated that they now use conservation farming despite the fact that there were few organizations to provide trainings. Farmers also explained that they have now reduced the number of seeds they plant per station, to either one or two seeds to reduce plant stress during dry spells.

Spraying in maize fields has also become a new trend when farmers just see pests for fear of the armyworms as they noted;

“Every time we have to buy spraying pesticides for their maize fields something that we never used to do in the past. The only challenge is that only few farmers can afford the pesticides. For most of us that cannot afford we usually depend on government distributed chemicals and it becomes a problem when pests emerge in our fields before the government bring the chemicals” (FGDs 27/07/2017, Mkando Village)

Similarly, people in Luangwa district are adjusting their livestock production practices due to climate change. People responded that they have a lot of goats now compared to 2 decades ago because goats seem to be less susceptible to diseases, water stress and pasture. Generally, it has been established (through matrix ranking during FGDs) that people are now having more livestock for the purpose of income diversification. The matrix ranking exercise where two types of livestock were compared in terms of preference and economic dependence, revealed the following order of preference: goats, poultry, pigs and cattle. Responses from both individual survey and FGDs also revealed that due to the shortage of water and pasture goats have replaced cattle on their importance because they are more resilient and adaptive than cattle (see table 5)

Table 4 : Livestock matrix ranking, (preference and economic dependence)

	Goats	Poultry	Cattle	Pigs	Score	Rank
Goats		(goats)	(goats)	(goats)	3	1
Poultry			(poultry)	(poultry)	2	2
Cattle				(pigs)	0	4
Pigs					1	3

Source: (Author’s FGDs)

Gardening is another activity that the people of Luangwa district practice on a very small scale to adapt to climate change effects. In Luangwa district the practice involves the production of different kinds of vegetables and the growing of maize during winter season. However, the study established that very few households (only about 10% of the total population of Luangwa) practice vegetable production due to the difficulty of irrigating crops, as this activity requires perennial water bodies, mostly rivers and streams, which are not common in the district apart from the two main rivers. People indicated that doing gardening along these rivers especially for vegetable production is not suitable because the river banks are very steep which makes water drawing impossible unless one has to use improved irrigation technology.

Results from FGDs from both Mphuka and Mburuma indicated that winter maize fields on the river banks are now getting too dry, and this is no longer a viable activity as it used to be in the past. Farmers also indicated that the two irrigation schemes at Kaunga and Mankhokwe are no longer working due to water shortage and unsustainable technology. Farmers have failed to repair the damaged irrigation solar equipment because they do not have income. Farmers responded that gardening is mostly being practiced along kaulungu stream in Chitope area which has water throughout the year, at the new Kavalamanja irrigation scheme and in few places near Luangwa Township around Chicendeende and Mandombe Villages.

4.3 Livelihood diversification

Due to the fact that agriculture is becoming more vulnerable to effects of climate change and that the yields are no longer sufficient and predictable, farmers in Luangwa district have sought to diversify with non-agricultural activities. From all the FGDs, and individual farmers' interviews, it was established that the three main alternatives to farmers in Luangwa district, in order of their importance and economic benefits, are charcoal production, fishing, and gardening. Charcoal production is practiced in both Mphuka and Mburuma chiefdoms, and has become a common practice in the district while in the past only few people used to practice this activity. Fishing is mostly done in the Luangwa river for those along the Luangwa bridge and Feira Road, and in Zambezi river for those living from Lunagwa Boma to Kavalamanja village.

It was also established that farmers started practicing these activities because of crop failure due to floods and drought, and that most seasons their crop yields have not been sufficient to take them through to the following season (FGD, 27/07/2017, Nyaukwindi). As a result of this, the people of Luangwa have opted to diversify their livelihoods. All the farmers individually interviewed and from FGDs said they will always do farming, but some of them have reduced the hectareage of their fields under cultivation. Even the District Agricultural Coordinator affirmed this situation as he highlighted that

“Farmers are not stopping farming, I would say they are combining or diversifying agriculture with other livelihood activities. You can verify this from the number of farmers in our district farmer register. The number is not reducing, but increasing, although at a very slow rate. What we have noticed instead is that the area under cultivation is the one that reduces in some cases, but not for all farmers” (DACO's interview, 24/07/2017).

Based on explanations from the DACO and farmers, the livelihoods framework lens reminds us that Scoones (2015: 41) use three broad clusters to explain causes and trajectories of livelihood change; intensification through capital investments or increasing either labour or land under cultivation, diversification of income sources including but not confined to coping strategies and lastly migration. Based on above responses, we can see that most farmers in the area cannot cope with climate hazards with farming alone, and have resort to adopting new ways of living, diversification, a situation which Mushongah (2009) calls “dropping out” and moving towards destitution. Those farmers who are “hanging in” barely surviving, struggling and failing to accumulate because of climate change, are more likely to eventually drop out. Thus, most farmers cannot intensify their farming activities because even if they may put more land under cultivation, or increase the capital in farming inputs, their yields would not improve and there would just be wastage of land, labour and capital due to climate change effects. Because of this, some of the farmers are reducing the areas under cultivation. According to Scoones (2015: 36) in livelihood strategies, if farmers reduce dependence of farming like the case is for Luangwa where they are reducing the sizes of their field, the situation become extensification of agriculture. Similarly, due to climate stress, about 5% households are migrating within the district looking for suitable areas where they can grow crops especially from areas around Mandonbe, Chidada and Soweto villages migrating to Janiero where agriculture does little better. FGDs responses also revealed that some households have moved to the neighbouring Chongwe district where farming is much higher yielding than in Luangwa.

The table below shows number registered verified farmers from the district agricultural register for the past 8 years showing a low increasing rate but not reducing.

Table 5: Farmer register – number of verified farmers

Season	Number of registered/verified farmers		
	Male	Female	Total
2009/2010	1,737	2, 123	3,860
2010/2011	2,094	2,160	4,254
2011/2012	2,147	2,157	4,304
2012/2013	2,147	2,142	4,316
2013/2014	2,209	2,176	4,385
2014/2015	2,237	2,198	4,435
2015/2016	2,244	2,238	4,482

2016/2017	2,290	2,224	4,514
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Source: (DACO's farmer Register)

4.3.1 Charcoal production

Charcoal production in tropical regions of the world is mostly understood to have negative ecological and environmental effects. Governments, NGOs, and public forestry institutions have been concerned about the effects of charcoal production. Deforestation is the mostly cited impact, which is defined as the clearing of forest or woodland leading to land use change (Chidumayo and Gumbo 2013: 87). However, while at a small spatial scale charcoal production involves deforestation, on a large landscape scale the result is mostly forest degradation. According to the World Energy Conference (World Energy Conference et al. 2004), charcoal is a fuel that is produced by carbonization of biomass, and the conventional process of production involves the extraction of biomass from natural forests in which natural regeneration is the main source of forest recovery. Although there are many investments now on use of different material to produce charcoal, the general pattern of almost complete dependence on natural forests for charcoal production accompanied by unsustainable harvesting, poor post-harvest management and its associated eventual environmental impact is the main concern for most of the conservation practitioners.

In Zambia, charcoal production for supply of fuel for conventional cook stoves contribute to numerous environmental threats (such as deforestation, anthropogenic climate change, biodiversity loss, low greenhouse gas sequestration potential and negative impacts on ecosystem services such as, water quality and quantity (Campbell et al. 2010, Chidumayo and Gumbo 2013). This is mainly because most of the methods and practices involved in the production of charcoal in the country are not sustainable and not eco-friendly. People do not follow recommended procedures and in most cases they do this without proper guidance. The situation has been exacerbated by high consumption of charcoal as a source of household energy.

In Luangwa district, charcoal production for Mphuka chiefdom is mainly practiced in Kavalamanja, Kakaro (adjacent to Nyakhongolo Hills), Mphuka central and Nyaukwindi areas. As for Mburuma, charcoal production has also become a main activity being practiced in Chiliwe area, and mostly Kaunga area involving a lot of farmers from surrounding villages (Interviewee, 26/07/2017, Mkando Village). Farmers interviewed individually and from FGDs affirmed they were all involved in charcoal production. They said charcoal production gives them quick income and that there was high demand both within the district and in Lusaka because of the current electricity crisis in the country. For those in Mphuka chiefdom, their market is mostly within the

district, Luangwa township residents are the main buyers while those in Mburuma chiefdom, especially Sipopa, Kabalo, Villi, Mkando, Chikokola, and surrounding villages produce their charcoal for Lusaka Market. Buyers from Lusaka come to buy in bulk and resale in Lusaka (during the transect walk, it was observed that even the type of the packaging in Muburuma was different from that from Mphuka, where they used empty, small cement bags (50kgs) while in Mburuma they use big (90kgs) empty bags suiting Lusaka market requirement). Methods of production do not support regeneration of trees as most people use fire to drop the trees and to chop them into pieces for use in the kilns. Production is also not regulated as everyone produces what they want from any part of the forests.

The District Forestry Officer (DFO) also confirmed that charcoal production was very high in the district and that 80% of the local residents are involved in charcoal production. He further said that;

“One of the main factors that has highly contributed to high levels of charcoal production is the 2015/2016 drought which left most of the farmers without crop yields” (DFO Interview, 28/07/2017).

The DFO indicated that timber exploitation exists but that it is not significant. For timber people target specific species of trees like *Pterocarpus Angolensis* (locally known as Mukwa or Mulonbe) and a few other hardwood species. The DFO also indicated that trees are mostly used for timber products in the district. He indicated that there were very few wild fruits that people collected apart from the common masau fruits from *Ziziphus Mauritania* tree. Other reasons for high rates of charcoal production are high poverty levels and population increase according to the district forestry officer. The DFO also explained that the process of charcoal production is not eco-friendly and hard to regulate as few producers purchase licences for charcoal production and conveyance, which comes with guidance for recommended harvesting methods and allocation of sites for charcoal production. Farmers from Mkando FGD also indicated that because there are very few trees remaining in their area because of charcoal burning, they cut down even tree like *Ziziphus Mauritania* which give them fruits because they want fast money from charcoal sales.

Learning from the works of Scoones (2015) and Chambers and Conway (1992) we understand that a livelihood is sustainable only if it can cope with and recover from stress and shocks, and maintain or enhance its capabilities and assets, while not undermining the natural resource base. In keeping with the findings of Campbell et.al (2010) and Chidumayo and Gumbo (2013), unsustainable, non-eco-friendly methods of charcoal production lead to serious environmental threats, charcoal production in Luangwa district is undermining the natural resource base, by fragmenting forests and

wildlife habitat, and contributing to biodiversity loss. This was confirmed by observations during a transect walk in the forest opposite Nyakhongolo hills and in Kavalamaja, where charcoal production has so fragmented the forest that elephants and other wildlife species were difficult to find, even at three water holes visited. Several groups of charcoal makers were observed going to the forest in the morning, and returning in the evenings and the resulting rate of forest clearing is very high.

In Zambia natural resources outside protected areas are managed mainly under the common property resources (CPRs) approach, which can lead to what some have described as the Tragedy of the Commons. Although the management and extraction of resources is regulated by both government and Community Resource Boards (CRB), most traditional land is treated as CPRs. However, the manner of use of CPRs makes forests in Luangwa particularly vulnerable to climate induced degradation (Blaikie et al. 1987: 187). In most cases, the use and extraction of resources from CPR's is widespread and dispersed, rather than site specific, and the forests in Luangwa have thus become direct victims of climate change induced charcoal production because everyone can extract from any part of the forest.

4.3.2 Fishing

Fishing has historically been, and remains, one of the main livelihood activities for most people in Luangwa district, practiced primarily along the Luangwa and Zambezi rivers (DC Interview, 25/07/2017). The people of Luangwa are known to have settled in the district because of the major two rivers which provide fish and because of the abundant wildlife for hunting (Interviewee, 26/07/2017, Kakaro village). The district still depends on fishing economically, as the main source of livelihood for most families. Climate change has increased the reliance on fishing, by impacting agricultural yields. Fishing has also been affected by direct effects of climate change, with reduced water levels in both rivers due to diminishing rainfall, and particularly the Luangwa. About 80% of the Luangwa river bed is sand during dry season (from August to December) with a very narrow channel of water that is not very suitable for fish. The people of Luangwa district have also contributed to the depletion of the fish due to unsustainable fishing practices. Over the past 10 years, fish stocks have greatly reduced in both rivers especially in the Luangwa river where there are no more fish conservation regulations being followed. Even the breeding fish ban period that applies to most rivers in Zambia (from December 01st to February 29th every years) is no longer observed due to recurrent droughts and flooding, that have resulted in widespread food shortages. In response, the government has been forced to relax the fish ban policy in Luangwa river to accom-

moderate livelihoods (interviewee, 27/07/2017, Mauneli village). As fish depletion has caused fishermen to increasingly cross to neighbouring Mozambique for fishing, the Mozambique government banned the entry of Zambian fishermen starting in January 2017. This has worsened the situation, increasing vulnerability, food security, and poverty problems in the district (DC interview, 25/07/2017).

Research data indicate that fishing is not a new skill for most of the local fishermen interviewed. They learnt the skill from their parents when they were still young and have always combined fishing with farming, and farming continues despite frequent low crop yields. Fishermen indicated that every month there are 15 more new fishermen this time while about 2 decades ago, there would be an average of 5 people joining in 2 months. The number of people joining fishing is increasing on daily basis, as most do not have enough crop yields to meet the year's harvest. It was also established that in the past ten years, a fishermen would only take roughly 30 minutes to catch one heap (1 Kilogram equivalent). The same yield now takes about 2 hours on average (Interviewee, 26/07/2017 Manueli). Fishermen generally complained that the decrease in fish has forced most of them to start fishing in neighbouring Mozambique. Practices thought to contribute to reduced fish levels included over fishing, not following fish conservation regulations, (the most common method of fishing, locally known as Kokota, destroys the eggs nests in the shallow, sandy parts of the rivers), wrong sized fishing nets (as fish stocks decline, increasingly smaller mesh sizes are employed for nets, including 2½ inches and below, seine nets, and even mosquito nets, which are not allowed by the Zambian government), the increased number of people fishing as a result of crop failure, and lack of alternative skills such as carpentry.

The fish market was ruled out as a main reason for overfishing as it was in existence in the days when people followed the fish ban and other conservation practices. But recently the practices have changed in the Zambezi as well as the Luangwa river. Based on responses from the fishermen, it is clear that there no conservation practices are being practiced, and that fishermen will seek ways of violating laws on fishing methods and nets, even if the laws are better enforced by the fisheries department. For these reasons, the resource will continue to diminish until conservation practices are embraced.

4.3.3 Poaching

Poaching, or the illegal killing of wildlife in violation of laws and rules, has only recently gained attention in the field of social science (Bell et al. 2007: 416). The prominent view of poaching in the ecological literature is associated with its impact being detrimental to biodiversity, a notion echoed by most conservation advocates. Motives of poaching are extremely diverse. Poaching can

serve non-economic needs as described by Curcione (1992) in Southern California, where illegal angling is a source of 'delight', or in Louisiana where Forsyth et al. (1998) suggests that illegal hunting represents resistance to the perceived imposition of alien cultural values. Similarly, Muth and Bove Jr (1998) identify 10 categories of motives for poaching, including household consumption, commercial gain, recreational practice, an act of rebellion, and an exercise of traditional rights. Nonetheless, in Luangwa, poaching is practiced predominantly as a means of subsistence.

In Africa in general, and particularly in southern Africa, the act of hunting dominated ancient life. As in much of Africa, poaching in Zambia has reached a crisis level, becoming a high priority policy issue (Nellemann et al. 2014). This is mainly because it threatens the viability of protected areas and the conservation of species in every biome, but also because poaching, alongside other forms of biodiversity exploitation and environmental crimes such as illegal commercial deforestation and unregulated fishing, can undermine sustainable development and detrimentally affect the livelihoods of the people living in proximity to wildlife (Bell et al. 2007)

The Luangwa district has been endowed with a plethora of wild animals and bird species resulting in the Lower Zambezi National Park and the Rufunsa Game Management Area (GMA) (Kaminsa 2008: 6). However, poaching levels have increased by an estimated 70% over the past ten years, and now involves about 60% of the local people (Senior Warden interview, 24/07/2017). The study noted that just this year (2017), between 5 and 15 cases of elephants poaching have been recorded (Senior Warden Interview, 24/07/2017). Even while interviewing the senior Warden, a white lodge owner from near the Amoro Village came to request a patrol team to investigate 4 gun shots in the area. Major species being poached include elephants, buffalos and kudus. The senior warden attributed the rise in poaching in the district to crop failure especially after severe droughts, as well as flooding, armyworms and high temperatures that have been recorded over the past ten years.

On the other hand the poaching of elephants has risen due to the emergence of the new markets for ivory, mostly in the capital city Lusaka, that are believed to be propelled by Chinese nationals. About 90% of arrest cases on elephant poaching and possession of ivory implicate Lusaka based buyers connected to Chinese nationals (senior warden interview 24/07/2017). This information also correlated with much of the contemporary literature on poaching, specifically on elephants and other endangered species, which attribute the rise in poaching to new markets in Asia. For instance Douglas-Hamilton (2009: 154) contend that both Africa and Asia have seen increasing reports of illegal killing of elephants and interception of illegal ivory hauls over the past few years, which are frequently associated with Chinese commercial activities. Similarly, Somerville (2016: 215) explains that the poaching of elephants and demand of ivory in Africa is driven largely by

Chinese economic expansion and the growth of a prosperous Chinese business class. A detailed study by Wittmeyer et al (2014) also estimated that between the years 2010 and 2012, 100,000 elephants were killed in Africa, which further supports a study showing that forest elephants in central Africa had declined by 60% between 2002 and 2011.

As much as low crop yields constitute an important reason among the factors contributing to high levels of poaching in the district, there is also a problem of low enforcement, as very few officers now man wildlife camps, allowing easier access to wildlife areas as compared to the past. As highlighted by the Chamitondo wildlife camp officer:

“I am alone at this camp, and it is difficult to make follow ups when I hear gunshots and also to control the entry gate. Sometimes when I am sleeping in the night I hear sounds of vehicles entering and coming out of the way leading to national park in the middle of the night and it is difficult to me to wake up and make follow ups. And this is the same with Kavalamanja wildlife camp where there is also only one officer and we are both just village scouts, not fully employed by the government” (Chamitondo wildlife camp officer interview, 28/07/2017).

The camp officer also indicated that in the past wildlife officers depended on the cooperation from the local people serving as key informants, who would quickly rush to inform wildlife officer about rumours of poaching, a situation that has changed. Local people are now involved in snare poaching and harbouring poachers from other areas like Lusaka and Chongwe district, giving them information about the movement of the wildlife officers on patrols to avoid arrest. All this is a result of crop failure and a lack of other sustainable alternative livelihood skills (wildlife camp officers interview 28/07/2017). The officer also explained that the Community Resources Boards are no longer effective at employing village scouts. They no longer do community sensitizations to make locals aware of the benefits of wildlife and the dangers of poaching. The practices highlighted above are undermining the integrity of the ecosystem and impacting wildlife numbers at an alarming rate. It is very evident from responses that there is little cooperation and involvement of the local people in the management process.

4.4 Policy, Power and the Role of the State

This section analyses factors that limit the capacity of the people in Luangwa district to adapt to current climate hazards. Using the political ecology framework, the study concentrated on understanding the interactions of different factors such as representation and marginalization, society and vulnerability, and abundance and degradation through overlapping structures of power and

conflicts between the rural people across various settlements in the districts and the enforcers and implementers of policies, projects and how this reinforce or minimise climate change vulnerability. As much as the rural people in Luangwa do acknowledge and commend the commitment by the Zambian government to uplift the fish ban in the Luangwa river, they feel there are still other policies that affect their capacity to cope with the current climate change vulnerability. The study established that the levying of products of the local people by the district council at the Maozeka check point was generally undermining their efforts to cope with the current situation. According to Zambian law, it is required that every product that leaves the district for sale has to be paid for based on the quantity. This includes all products including local wild fruits like Masau (small apple like fruits from *Ziziphus Mauritania* tree), reed matts, fish, art and craft products and may more. As one interviewee stated, but this statement resonates in many other interviews;

“it is not fair for the council to be levying us for little and small products that we hope to sustain our families from, it would make sense if they would allow the local people to take their products to the market without being charged but effect the charges for those who transport a lot for business mostly not the local people” (interviewee 27/07/2017, Makando village).

People therefore feel that this policy is undermining their capacity to adapt. To understand this further, Robbins (2011: 20) emphasizes that when using political ecology, research should reveal differential power conflicts that produce the social environmental outcomes causing loss of biodiversity. It follows that as people are subjected to policies that require them to pay in the climate critical situation, they are forced to degrade more of natural resources as they have to find money to pay for the levies.

Farmers also explained that there are very few climate change adaptation programs being implemented in the district. The DACO and Farmers only identified one NGO, the Luangwa Child Development Project in partnership with Child Fund Zambia (CFZ), which only has a few projects that only target households with benefiting children, and therefore very few households' benefit. This project has little impact on their capacity to adapt to climate change. This was also confirmed by another study conducted by Caritas Zambia (Network and Zambia 2015: 36) which found that there were few climate change adaptation programs in the district despite the country having received a lot of climate change adaptation funds starting the year 2010. The network and Zambia (2015: 8) contends that beginning the year 2010, Zambia has been receiving large commitments from climate change funds and bilateral donors. Priority sectors for these funds have been adaptation projects including governments, water supply, civil society and agriculture among others. Despite these funds, some parts of the country do not have adequate climate change adaptation

projects. People explained that they were not aware of how areas are selected to benefit from climate change adaptation projects. In fact 90% of the interviewed households did not even know what adaptation means. Farmers explained that their views and input are not represented in the formulation and selection of the few projects to be implemented. People felt that they were less represented, and there was a missing role of the civil society organisations, they said;

It would be better if there could be community organisations (such as Civil Society Organisations CSO) that could link us with the government to better plan and design adaptation projects. This can help our voices be heard and advocate for policy change unlike the area councillors that we have they are not well informed about climate change issues so they do little to help (FGD, 27/07/2017, Mkando Village)

Farmers explained that CSOs can help them understand the complexities of climate change adaptation, follow up with the governments on projects, and track funds received for adaptation projects in their communities. To understand this, the study by Network and Zambia (2015: 8) contends that this happens because the Zambian government does not always allow community members to contribute to project planning. The above interplay of multiscale power dynamics of participation and representation is what Taylor (2014: 3) and Robbins (2011: 20) suggest should be given attention to as we apply the political ecology framework to understand the outcomes in the lived environment and the social and physical landscape which lead to biodiversity loss.

In Luangwa district, community resilience is undermined by a lack of representation and little involvement of the local people in planning climate change adaptation projects. Farmers also noted that if they were allowed to participate in planning of the projects, they would seek more irrigation improvement projects due to the proximity to two major rivers, to allow crops to be grown throughout the year and reduce dependence on rain fed agriculture.

On another note, both individual survey and FGDs, 90% of farmers indicated that they would want to grow sorghum and not maize, due to the vulnerability of maize to the effects of climate change. People prefer sorghum because both the local varieties and early maturing hybrid varieties can withstand the drought stress the district is experiencing. They indicated that due to limited incomes purchasing seed is impossible, and the security of the local seeds was lost in when the government and the colonial masters introduced Maize. From that time, most farmers stopped keeping seeds for sorghum, and only few farmers

still have the seeds for the local varieties of sorghum. The farmers feel that since the government introduced maize, similar efforts should be made to provide sorghum seed for farmers to help cope with the current climate change effects. For instance one woman in Mkando village said;

“Since it is the government that introduced Maize growing to our grandparents, our grandparents stopped keeping sorghum seeds. Today most of us now do not have the sorghum seed which the government is again telling us to grow now because of climate change. Let the government give us seed then” (Interviewee, 27/07/201, Mkando Village).

From the responses of farmers, the government is to blame for the policy that replaced the climate change resilient staple crop, without warning them to continue growing sorghum in case of weather changes. Now farmers need the government support, especially seeds that can cope with the droughts that the district faces.

Chapter 5: Conclusion

Effects of global weather change have been observed in many parts of the world. These pose significant risks to people's livelihoods, especially in rural areas where the majority of inhabitants depend on climate sensitive resources. Since livelihoods are subject to limitation through natural forces, combined with climate variability, people are required to adjust their livelihoods which is associated with residual damage to the environment that in-turn contributes to climate change (in the case of charcoal).

This research sought to explain how climate change vulnerability in Luangwa district of Zambia has reshaped peoples' livelihoods and the resulting environmental impacts of such climate induced livelihoods. Employing various research techniques, the study collected data that was analysed in the context of theory, to explain how climate change affects rural livelihoods and how climate change vulnerability leads to adaptation practices that lead to biodiversity loss.

To understand climate change impact in Luangwa district, the study relied on primary data collected on; (i) peoples' perceptions about climate variability, (ii) climate change impact on agriculture using crop yields and (iii) rainfall variability. Results confirm that weather events have been changing, causing a high likelihood of livelihood vulnerability. Iwasak and Shaw (2010: 101) suggest that climate change affects not just occupational activities, but multifaceted aspects of livelihoods that determine the extent of peoples' capacity to adapt. In Luangwa, the main economic livelihood activity, agriculture, and its aligned activities such as livestock, have been highly affected by climate change hazards such as drought, floods and pests.

Entitlements, mostly generated by livelihoods, have equally been affected and everyone in the district who is not formally employed, and especially the rural dwellers, has been affected. Climate change vulnerability has limited the adaptive capacity of the agricultural sector leaving the people of Luangwa near destitution. In trying to cope with this, people engage with various livelihood activities, while not completely abandoning farming. The grey area that this research also sought to address is the aspect of the residual impacts of adaptation that leave damage on the environment as explained by Shaw (2006: 2). The Luangwa district has followed the common process of adaptation accompanied by costs and residual environmental damage, stemming from a lack of income to engage with sustainable non extractive livelihood activities.

Guided by Scoones (2015: 36) "sustainable rural livelihood framework", the research demonstrated how the people of Luangwa are now diversifying livelihoods, supplementing farming with

poaching, charcoal production, fishing and gardening. As people try to diversify, they intensify on charcoal production, fishing and poaching while extensifying on agriculture by reducing the sizes of farming areas as demonstrated by the study. The study also showed that those unable to cope try to migrate to neighbouring villages and districts in search of practices that can help them cope with climate change hazards. Also by paying attention to wider institutional, cultural and policy contexts, as well as seasonality shocks, the sustainable livelihood and political ecology lenses revealed processes that push people into undesirable rejection. This was demonstrated by reviewing peoples response on factors limiting their capacity to adapt in comparison to policies that either reinforce climate change vulnerability or enhance adaptation.

The paper maintains that when climate change adaptation by the rural people is not assisted by either governments or the private sector, it becomes detrimental to natural resources. Further, the study argues that climate change and biodiversity studies should include the aspect of human interaction with nature due to changing livelihoods because of climate variation. This explains the high natural resource extraction dependence in Luangwa, due to high rates of wildlife poaching, deforestation through charcoal production, and overfishing. Based on the results of study, these practices will not stop until projects and programs are implemented to assist communities to sustainably adapt. As demonstrated by this study, there are very few climate change programs being implemented in the district despite Zambia being one of the countries receiving a lot of funding for climate change adaptation. It is beyond the scope of this paper to provide detailed account of policy on how NGOs and the government select areas to target for climate change adaptation, but this could be a possible area for future research. Further related social science research needs in the district include how natural resources are an important asset for climate change adaptation. Natural sciences studies could also help assess the rate of reduction in forest cover and wildlife population due to climate change vulnerability.

This study is highly relevant in the context of the study of, and debate over global climate change, because the findings are not contextual. Similar outcomes could be expected anywhere climate change effects areas endowed with natural resources.

References

- Bell, S., K. Hampshire and S. Topalidou (2007) 'The Political Culture of Poaching: A Case Study from Northern Greece', *Biodiversity and Conservation* 16(2): 399-418.
- Blaikie, P., H. Brookfield and B. Allen (1987) *Land Degradation and Society*. London: Methuen.
- Brammer, H. (1987) 'Drought in Bangladesh: Lessons for Planners and Administrators', *Disasters* 11(1): 21-29.
- Campbell, D., M. Fiebig, M. Mailloux, H. Mwanza, J. Mwitwa and J. Sieber (2010) 'Zambia Environmental Threats and Opportunities Assessment (ETOA)', *Zambia, USAID*.
- Chambers, R. and G. Conway (1992) *Sustainable Rural Livelihoods: Practical Concepts for the 21st Century*. Institute of Development Studies (UK).
- Chidumayo, E.N. and D.J. Gumbo (2013) 'The Environmental Impacts of Charcoal Production in Tropical Ecosystems of the World: A Synthesis', *Energy for Sustainable Development* 17(2): 86-94.
- Curcione, N. (1992) 'Deviance as Delight: Party- boat Poaching in Southern California', *Deviant Behavior* 13(1): 33-57.
- Dautu, G., C. Sindato, A.S. Mweene, K.L. Samui, P. Roy, R. Noad et al. (2012) 'Rift Valley Fever: Real Or Perceived Threat for Zambia?', *Onderstepoort Journal of Veterinary Research* 79(2): 94-99.
- Dawson, B. and M. Spannagle (2008) *The Complete Guide to Climate Change*. London: Routledge.
- Dorward, A. (2009) 'Integrating Contested Aspirations, Processes and Policy: Development as Hanging in, Stepping Up and Stepping Out', *Development Policy Review* 27(2): 131-146.
- Douglas-Hamilton, I. (2009) 'The Current Elephant Poaching Trend', *Pachyderm* 45(1): 154-157.
- Eriksen, S.H. and K. O'brien (2007) 'Vulnerability, Poverty and the Need for Sustainable Adaptation Measures', *Climate policy* 7(4): 337-352.
- Forsyth, C.J., R. Gramling and G. Wooddell (1998) 'The Game of Poaching: Folk Crimes in Southwest Louisiana', *Society & Natural Resources* 11(1): 25-38.
- Gilbert, G.N. (2008) *Researching Social Life*. (3rd ed. edn) London: SAGE.
- Hartung, C., A. Lerer, Y. Anokwa, C. Tseng, W. Brunette and G. Borriello (2010) 'Open data kit: tools to build information services for developing regions', Proceedings of the 4th ACM/IEEE International Conference on Information and Communication Technologies and Development, ACM pp18.

- Islam, T., M. Aminur Rahman and F. Mallick (2010) 'Chapter 2 Impacts of Climate Change Induced Hazards and Adaptation Processes in Bangladesh: An Overview', 'Chapter 2 Impacts of Climate Change Induced Hazards and Adaptation Processes in Bangladesh: An Overview', *Climate Change Adaptation and Disaster Risk Reduction: An Asian Perspective*, pp. 19-36. Emerald Group Publishing Limited.
- Iwasaki, S. and R. Shaw (2010) 'Integrated Climate Change Adaptation in Chilika Lagoon Fisheries, India', in S. Iwasaki and R. Shaw (eds) *Climate Change Adaptation and Disaster Risk Reduction: An Asian Perspective*, pp. 81-103. Emerald Group Publishing Limited.
- Jain, S. (2007) 'An Empirical Economic Assessment of Impacts of Climate Change on Agriculture in Zambia', Policy Research Working Paper 4291, No. 4291, pp. 1-31. Washington, DC: The World Bank.
- Kalantary, C. (2010) 'Climate Change in Zambia: Impacts and Adaptation', *Global Majority E-Journal* 1(2): 85-96.
- Kaminsa, D. (2008) 'Integrated Development Planning and Disaster Risk Management: A Case of Luangwa District', No. 1, pp. 1-11. Lusaka: Department of Physical Planning and Housing.
- Kelly, P.M. and W.N. Adger (2000) 'Theory and Practice in Assessing Vulnerability to Climate Change and Facilitating Adaptation', *Climatic Change* 47(4): 325-352.
- Krishnamurthy, K.P., Lewis Kirsty, Chris Kent and Pramod Aggarwal (2015) 'Climate Impacts on Food Security and Livelihoods in Asia: A Review of Existing Knowledge', pp. 1-18. United Kingdom: World Food Programme.
- Kusena, K. (2009) 'Land Cover Change and its Impact on Human-Elephant Conflicts in the Zimbabwe, Mozambique and Zambia (ZiMoZa) Transboundary Natural Resource Management Area', Nature conservation and Land Resources - land economics and policies. Uppsala: SLU, Swedish Biodiversity Centre.
- Luginbill, P. (1928) *The Fall Army Worm*. Vol. 34. Washington, DC: US Dept. of Agriculture.
- McSweeney, C., G. Lizcano, M. New and X. Lu (2010) 'The UNDP Climate Change Country Profiles: Improving the Accessibility of Observed and Projected Climate Information for Studies of Climate Change in Developing Countries', *Bulletin of the American Meteorological Society* 91(2): 157-166.
- MTENR (2007) 'Formulation of the National Adaptation Programme of Action on Climate Change - Final Report (September 2007)'. Lusaka: Republic of Zambia, MTENR.
- Mucavele, F.G. (2013) 'True Contribution of Agriculture to Economic Growth and Poverty Reduction: Malawi, Mozambique and Zambia Synthesis Report', pp. 1-22. Lilongwe: Malawi National Digital Repository.
- Muchanga, M. (2012) 'A Survey of Public Participation in Planning for Climate Change Adaptation among Selected Areas of Zambia's Lusaka Province' 2(8) Mulenga, B.P., A. Wineman and N.J. Sitko (2014) 'Climate Trends and Farmers' Perceptions of Climate Change in Zambia', *Environmental management* 59(2): 291-306.

- Mushongah, J. (2009) 'Rethinking Vulnerability: Livelihood Change in Southern Zimbabwe, 1986-2006', *Rural development*. Brighton: University of Sussex.
- Muth, R.M. and J.F. Bowe Jr (1998) 'Illegal Harvest of Renewable Natural Resources in North America: Toward a Typology of the Motivations for Poaching', *Society & Natural Resources* 11(1): 9-24.
- Nellemann, C., R. Henriksen, P. Raxter, N. Ash and E. Mrema (eds) (2014) *The Environmental Crime Crisis: Threats to Sustainable Development from Illegal Exploitation and Trade in Wildlife and Forest Resources*. Nairobi: United Nations Environment Programme (UNEP).
- Network, Z.C.C. and C. Zambia (2015) 'Adaptation Finance Accountability Initiative: Zambia Country Report', pp. 1-49. Lusaka: Oxfam, Zambia Episcopal Conference.
- Nkomwa, E.C., M.K. Joshua, C. Ngongondo, M. Monjerezi and F. Chipungu (2014) 'Assessing Indigenous Knowledge Systems and Climate Change Adaptation Strategies in Agriculture: A Case Study of Chagaka Village, Chikhwawa, Southern Malawi', *Physics and Chemistry of the Earth, Parts A/B/C* 67: 164-172.
- Nolin, J. and C. von Essen (2005) 'Conservation Farming in Zambia; A Study of Adoption among Stakeholders in Southern Zambia and Minor Soil Fertility Study Comparing Conventional Tillage and Conservation Tillage.', Department of Soil Science. Uppsala: Swedish University of Agricultural Sciences.
- O'Leary, Z. (2014) *The Essential Guide to Doing Your Research Project*. (2nd edition. edn) London: SAGE.
- Olsson, L., M. Opondo, P. Tschakert, A. Agrawal and S.E. Eriksen (2014) 'Livelihoods and Poverty', in Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (ed.) *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, pp. 793-832. Cambridge, UK and New York, USA: Cambridge University Press.
- Parry, M., O.F. Canziani, J.P. Palutikof, van der Linden, Paul J and C.E. Hanson (2007) *Climate Change 2007: Impacts, Adaptation and Vulnerability*. Vol. 4. Cambridge: Cambridge University Press.
- Patton, M.Q. (2002) 'Qualitative Interviewing', *Qualitative research and evaluation methods* 3: 344-347.
- Robbins, P. (2011) *Political Ecology: A Critical Introduction*. Vol. 16. Oxford: John Wiley & Sons.
- Scoones, I. (2015) *Sustainable Livelihoods and Rural Development*. Rugby, UK: Practical Action Publishing.
- Scoones, I. (1996) *Hazards and Opportunities: Farming Livelihoods in Dryland Africa. Lessons from Zimbabwe*. London: Zed Books.

- Sen, A. (1981) *Poverty and Famines: An Essay on Entitlement and Deprivation*. Oxford: Oxford university press.
- Shaw, R. (2006) 'Community-Based Climate Change Adaptation in Vietnam: Inter-Linkages of Environment, Disaster, and Human Security', *Multiple dimensions of global environmental change*: 521-547.
- Shaw, R., J.M. Pulhin and J. Jacqueline Pereira (2010) 'Chapter 1 Climate Change Adaptation and Disaster Risk Reduction: Overview of Issues and Challenges', 'Chapter 1 Climate Change Adaptation and Disaster Risk Reduction: Overview of Issues and Challenges', *Climate Change Adaptation and Disaster Risk Reduction: Issues and Challenges*, pp. 1-19. Emerald Group Publishing Limited.
- Smit, B. and J. Wandel (2006) 'Adaptation, Adaptive Capacity and Vulnerability', *Global Environmental Change* 16(3): 282-292.
- Somerville, K. (2016) *Ivory: Power and Poaching in Africa*. London: Hurst & Company.
- Stocker, T., D. Qin, G. Plattner, M. Tignor, S. Allen, J. Boschung et al. (2013) 'IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change'.
- Taylor, M. (2014) *The Political Ecology of Climate Change Adaptation: Livelihoods, Agrarian Change and the Conflicts of Development*. London and New York: Routledge.
- Wittemyer, G., J.M. Northrup, J. Blanc, I. Douglas-Hamilton, P. Omondi and K.P. Burnham (2014) 'Illegal Killing for Ivory Drives Global Decline in African Elephants', *Proceedings of the National Academy of Sciences of the United States of America* 111(36): 13117-13121.
- World Energy Conference, World Energy Council and Bundesanstalt für Geowissenschaften und Rohstoffe (2004) 'Survey of energy resources', World Energy Conference.
- Zambia, C. (2015) '2010 CENSUS OF POPULATION AND HOUSING; Population Summary Report', pp. 1-154. Lusaka: Central Statistical Office.

Appendices

Appendix 1: List of Government heads of departments (Key Informants) Interviewed

Name of Participants	Organization	Position	Date interviewed
Mr Ngoni Moyo	District Administration's Office	District Commissioner (DC)	25/07/2017
Mr Ernest Munthali	Department of Agriculture	District Agricultural Coordinator (DACO)	24/07/2017
Mr Harry Phiri	Department of National parks and Wildlife	Senior warden	24/07/2017
Mr Levey Nyangulu	Forestry Department	District Forestry Officer (DFO)	28/ 07/2017

Appendix 2: Table showing Summary of major climatic events and impact

Based on the responses of the study, a summary of major climatic events and risks affecting livelihoods in Luangwa district was generated;

Summary of major climatic events and impact

Year	Key events	Impacts
1990/1991	Severe prolonged drought	Famine/hunger due to crop failure
2000/2001	Flash floods	Crop submersion and suffocation resulted in famine
2006/2007	Flash floods	Crop failure resulted in famine
2007/2008	Severe prolonged floods	Livestock lost (goats, cattle and poultry, due to disease from floods), 28 houses destroyed, Luangwa main market submerged, main road washed away, cutting off the district from the rest of the country and severe famine due to crop loss.

2010/2011	Severe prolonged drought	Crops dried at reproductive stage, resulting in severe famine and hunger. Livestock highly affected no grass for pasture
2015/2016	Flash floods, emergence of the army worms pests	Crop failure resulted in famine and hunger, from both drought and army worms
2016/2017	Army worms and flash floods	Famine due to crop failure as result of army worms and floods.

Source: Author's FGD field data

Appendix 3 : Farmers Questionnaire

FarmerForm ID#.....

Introduction

Hallo! My name is Handsen Mseteka a student from the International Institute of Social Studies of Erasmus University Rotterdam in the Netherlands. I am conducting a research study on the impact of the impact of climate change adaptation on the environment in Luangwa district as part of my dissertation leading to the award of Masters Degree in Agrarian, Food and Environmental studies. The answers that you will provide will be confidential and used only for academic purposes. I would be grateful for your assistance in responding to the following questions to the best of your knowledge and if you do not know the answers to the questions, feel free to indicated so. You are also free to discontinue the interview at any time should you feel so, but I value your contribution to this research. Thank you in advance.

Section A; General Identification Information and Household characteristics

1. Province.....
- 2.District.....
3. Name of village.....
- 4.Name of Agricultural Camp.....
5. Date.....
- 6.Ward Name.....

Livelihood activity	Year started

22. Why did you start practicing these activities? Diversification [] Crop failure due to drought, [] Crop failure due to floods [] crop failure due to pests [] New Market for products [] other specify?

23. If the answer to question 22 is new markets, who is providing the market and since when?

24. Have you ever considered stopping farming to fully depend on other livelihood activities due to rainfall uncertainties?

25. Have other farmers stopped farming within your location due to crop failure as a result of reduced rainfall? Yes [] No [] don't know []. If Yes how many?

26. Those that have stopped farming, what is their main source of livelihood? Fishing [] charcoal production [] poaching [] other, specify.....

27. What would you attribute the current change of livelihood from farming to these other livelihood activities?

Section D: Factors Limiting Adaptation

28. Are there factors that you think somehow limit your capacity to cope with climate change hazards? Yes [] No []

29. If Yes, give details.....

30. Does the government assist you with programs to help you cope with climate change? Yes [] No []

31. If Yes give details of the programs.....

32. Are there government policies that limit your capacity to adapt with the current climate change problems? Yes [] No []

33. If Yes give details of the policies.....

34. Are there NGOs trying to assist you with climate change adaptation programs? Yes [] No []

35. If Yes give details.....

36. Do you in any way feel that the programs being implemented by NGOs somehow limit your capacity to adapt with climate change effects? Yes [] No []

37. If Yes give details.....

38. Any comment

Thank you for your time!!!

Appendix 4 : Farmer Focused Group Discussions Questions Guide

FFGDform ID #.....

Name of village..... Name of Agricultural Camp.....

Date..... Ward Name.....

A. Farming Activities Questions

1. Have you noticed any change in rainfall pattern/ distribution of the past few 10 years
2. If Yes how? Please describe the changes,
3. What do you think is causing this rainfall change over these years?
4. How have the crop yields been in these years?
5. At what stage of crop growth does the rainfall mostly stop?
6. Apart from rainfall problems, what other factors affect the growth of the crops and the yields?
7. During which months do you run out of food? Draw a food security calendar with famers.
8. When you finally run out of food how you do cope to reach the following crop harvest?

B. Livelihood Change Questions

9. List 3 main livelihoods activities (in order of their importance) that you depend on to cope with climate induced food shortfalls – use matrix ranking on a flip chart

10. Do you practice these livelihoods alongside farming or you have to reduce or quit farming?
11. Since when have you been practicing these livelihood activities?
12. Why have these activities been widely adopted by the majority of the community?
13. Are there households in Luangwa that you have heard have stopped farming and opted for other activities?
14. How would you rate (**level of extraction, according to economic benefits and impact on the environment**) charcoal production and fishing in this community?
15. Why do you think the problems stated in 14 are high or low?

C. Factors Limiting Adaptation

16. Are you aware of climate change? How?
17. Are there factors that limit your capacity to adapt to climate change? If Yes specify
18. Who is more affected by climate change in your community between the poor and the rich? Give reasons
19. Who is more affected by climate change in your community between Female Headed Households and Male Headed households? Give reasons
20. Who is more affected by climate change in your community between the old aged and the young? Give reasons
21. Who is more affected by climate change between those living in villages and those living in urban areas? Give reasons
22. Who is more affected by climate change between those with employment and those not? Give reasons
23. Are there government and or NGO programs on climate change adaptation being implemented in this community? Specify
24. To what extent do these programs empower communities to adapt with the current climate change hazards?
25. Are there government policies that you think limit rural people's capacity to adapt with climate change? If yes specify
26. What factors limit your capacity to engage with sustainable none extractive livelihood options?
27. How has the dependence on livelihood activities that depend natural resources as a result of climate change impacted on your community? Are people aware of these dangers?

Appendix 5 : Fishermen Questionnaire

FishermenForm ID#.....

Name of village.....Name of Agricultural Camp.....

Date..... Ward Name.....

Gender: Male [] Female [] Other []

1. How long have you lived in this location/ Village? []years
2. When did you start Fishing? [] Explain how if you started fishing in your childhood and if this has been your main occupation since then
3. What other livelihood activities do you depend on to support household need? Farming [] charcoal production [] Other, Specify.....
4. Do you practice farming on full time basis? Yes [] No [] Part time []
5. If No why did you stop farming?
6. When did you stop farming []year
7. Would you link this to climate change? Yes [] No [] How? Give details
8. Do you sustain your family needs from fishing? Yes [] No []
9. How long does it take you to catch enough fish for one heap now and five years ago? Now [] hours. Five years ago [] hours
10. Why is there a difference between now and five years ago?
11. How many people join fishing every year now compared to five years ago? Now [] people/year. Five years ago []people/ year
12. If the number is increasing why do you think there is an increase?
13. Does every fisherman in this location follow the fishing regulations, i.e fish barn, right net sizes e.t.c Yes [] No []
14. How do you sustain you family needs when you do not get enough fish to support your family?.

15. Are you aware of the dangers of depending on fishing as an example of extractive resources? Yes [] No []
16. What factors limit you capacity to engage with non-extractive sustainable livelihoods?

Appendix 6 : Wildlife Camp Officers' Questionnaire

WildlifeOfficerForm ID#.....

Name of Wildlife camp..... Name of the Officer.....

Position Gender

Date..... Ward Name.....

1. For how long have you worked from this Camp? [] years
2. How is are the poaching levels around this area? High [] Low [] Moderate []
Give objective details as signs of your answer
3. How often do you spot wildlife compared to ten years ago? At least three major wildlife species
4. What wildlife species are mostly being poached?
.....
5. How were poaching levels around this area about 10 years ago? High [] Low []
Moderate []
6. How often do you hear gun shots around this area? Give details
7. How often to you hear of game meat being traded in this community? Give details
8. How often do you encounter poachers when you go for patrols now compared to ten years ago?
9. According to you what, are there reasons for these changes in wildlife populations? Give details.....
10. Would you relate the current peoples' crop yields to poaching levels in this area? Give details

11. To what extent are local people involved in poaching based on you arrest cases? Low (10%) [] High (above 50%) [] Moderate (about 20% – 30%) [] None (0%) []
12. About the current poaching levels which factor has the great share as a contributing factor? Market [] Climate induced crop failure []
13. If the answer is market in question 8, who is providing market and for what trophies?
.....
14. What factors do you think limit rural peoples' capacity to adapt to climate change and engage in sustainable non extractive livelihoods?.....