

**LIVELIHOOD DIVERSIFICATION TO COMBAT CLIMATE CHANGE EFFECTS IN  
SIACHITEMA CHIEFDOM, KALOMO DISTRICT.**

**BY**

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## **DECLARATION**

I, DERRICK BWALYA, do hereby declare that, with the exception of quotes and information done by others, which I have made reference to and duly acknowledged herein, this dissertation has been written and compiled by me and the work recorded is as a result of my own research. The dissertation has not been previously submitted for a degree, diploma or any other qualification at this or any other University.

**March, 2023**

**Signature.....**

**Date.....**

## **CERTIFICATE OF APPROVAL**

This dissertation of DERRICK BWALYA has been approved as fulfilment of the requirements for the award of a Master of Science degree in Geography by the University of Zambia.

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## **ABSTRACT**

Empirical evidence from a variety of different locations suggest that livelihoods diversification is happening. Rural households do indeed engage in multiple activities and rely on diversified income portfolios in order to increase their resilience to climate change effects (Ellis, 1997). In sub-Saharan Africa, a range of 30–50 per cent reliance on non-farm income sources is common; but it may attain 80–90 per cent in southern Africa. In view of these concerns, the study aimed at investigating the extent to which livelihood diversification strategies adopted by people in Siachitema Chiefdom have contributed to combating effects of climate change. The study used mixed-method approach and convergent parallel design was employed. A total of 200 randomly sampled smallholder farmers from Siachitema chiefdom were interviewed. The objectives were: (a) To rate the severity of the effects of climate change on identified livelihood, (b) To assess the livelihood diversification strategies adopted by residents of Siachitema to withstand climate change effects, (c) To analyze the contribution of livelihood diversification strategies to household food security. The research questions were: (a) what livelihoods are common among residents of Siachitema? (b) How severe are the effects of climate change on local livelihoods in Siachitema Chiefdom? (c) What livelihoods diversification strategies have been adopted by residents of Siachitema Chiefdom to combat climate change effects? (d) To what extent do livelihoods diversification strategies contribute to household food security? Further, 10 key informants were purposively sampled. The Least Square Difference (LSD), Analysis of Variance (ANOVA) and Spearman Rank Correlation were used to analyze quantitative data. Qualitative data were analyzed using thematic analysis. The data were closely examined to identify common themes and patterns arising from the data set. Analysis of collected data revealed that climate change had very severe effects on common livelihoods, particularly on crop and livestock farming. The effects of climate change on the common livelihoods involved stunted growth of crops, reduced soil moisture content, increase in pests and pathogens, crop failure, decrease in crop yields, and destruction of crops by intermittent floods. The effects on livestock farming included, increase in temperature; shortage of fresh water, shortage of forage, mastitis, a disease which caused inflammation of the udder, foot root, increased death of livestock, and heat stress. Effects on gardening included: shortage of water to support growth of vegetables, increase in temperature which destroyed vegetables. Residents of Siachitema chiefdom diversified their livelihoods in order to combat the effects of climate change. The diversification of livelihoods was categorized into (i) On-farm:

Conservation agriculture (Ripping and Ground Basin), 45% of smallholder farmers interviewed adopted conservation agriculture. Ripping the land allowed for minimum tillage, potholing (ground basins) involved digging big and small holes respectively on the ground, planting early maturing crops had 100% adoption rate, planting drought tolerant crops 60% adoption rate, keeping small ruminants 80% adoption rate, intercropping 73% adoption rate, application of cow dung as fertilizer 27% adoption rate, migrating animals to places with water and forage 54% adoption rate; (ii) Non-farm: engaging in piece works in urban areas had 47% adoption rate, molding bricks 26% adoption rate, engaging in village banking 18% adoption, registering for social cash transfer 32% adoption, petty trading 41% adoption, charcoal burning 39% adoption; brick laying 21% adoption rate (iii) Off-farm: doing piece works in other people's farms 12% adoption. The adopted strategies made significant contribution to household food security. Diversification helped farmers to improve their food security situation better than it was before they started diversifying. Diversification of crops in particular had a positive and significant effect on household food security. It is concluded that the livelihoods of smallholder farmers in Siachitema chieftdom are affected by impacts of climate change. Changes in climate has an impact on the livelihoods of farmers through recurrent drought, high temperatures and occasional floods. Smallholder farmers resorted to diversifying their livelihoods in order to increase income generation and ensure sustainability. The study recommends that Government should consider subsidizing the prices of magoye rippers. This will promote increased adoption of conservation farming and increase smallholder farmers' resilience to climate change effects. Government through Ministry of local Government and rural development should consider providing soft loans to smallholder farmers at low interest rate. This will promote non-farm activities such as business and subsequently reduce reliance on on-farm activities which have been threatened by climate change. In terms of policy direction, there is need to establish climate change and food security network and developing a comprehensive communication plan to share information with regards to climate change effects, vulnerability, adaptation and mitigation. Further, conservation agriculture should not only focus on technical approaches to increase adoption rates but also consider the social aspects like perceptions.

**KEYWORDS:** Mixed research methods, smallholder farmer, conservation agriculture, livelihood diversification, and food security

## **DEDICATION**

This dissertation is dedicated to my amazing and beloved mother, PEGGY MWIIMBI SIKANYITI. Words can hardly describe my thanks and appreciation to you. You have been my source of support, guidance and inspiration. You have taught me to be determined, unique, to believe in myself and to always persevere. I am truly thankful and honored to have you as my mother.

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## **ACRONYMS AND ABBREVIATIONS**

|       |   |                                           |
|-------|---|-------------------------------------------|
| AER   | : | Agro-Ecological Region                    |
| ANOVA | : | Analysis of Variance                      |
| CBD   | : | Central Business District                 |
| DFID  | : | Department for International Development  |
| FAO   | : | Food and Agriculture Organization         |
| GRZ   | : | Government of Republic of Zambia          |
| IGP   | : | Indo-Gangetic Plain                       |
| IPCC  | : | Intergovernmental Panel on Climate Change |
| MoA   | : | Ministry of Agriculture                   |
| NGO   | : | Non-Governmental Organization             |
| UNDP  | : | United Nations Development Programme      |

## **CHAPTER ONE: INTRODUCTION**

### **1.1 Introduction**

This chapter explains the different parts found under introduction. It will start by first explaining the background of the study and the statement of problem. Thereafter, it will explain the Aim, Objectives, Research Questions as well as the Rationale of the study.

### **1.2 Background**

Climate change involves a long-term increase in average temperatures as well as increase in climate variability due to increased concentration of greenhouse gases in the earth's atmosphere (De Forges, 2019). The emissions of greenhouse gases have increased by 70 percent since the 1970s, due to human activities (IPCC, 2001). The increased greenhouse gas emissions have led to increased trapping of longwave radiation contributing to increased greenhouse effect (IPCC, 2007). Studies done in different parts of the world have shown that there is a wide agreement among the scientific community that climate change is taking place and has impacted people's livelihoods (Kalantary, 2010). Climate change has severely affected livelihoods dependent on climate-sensitive sectors such as rain-fed agriculture. The capacity of agriculture to meet food demand and sustainably support livelihoods is increasingly threatened thereby adversely affecting food security (Kalantary, 2010).

Climate shocks such as drought, flooding, and extreme temperatures are expected to increase in frequency and intensity, and these impacts are projected to increase over time (Nelson and van der Mensbrugghe, 2013). In the absence of measures to reduce the vulnerability to, and impacts of, such extreme events, they can be expected to generate significant negative impacts on food security (FAO, 2010; Foresight, 2011). To address the impacts of climate change, livelihood diversification strategies are implemented by households in rural areas as a response to climate change shocks. Most households in rural areas of third world countries largely depend on rain-fed agriculture for their livelihoods and, as such, are highly dependent on climatic conditions. Recent evidence and projections indicate that global climate change is likely to increase the incidence of natural hazards, including the variability of rainfall, temperature and occurrences of climatic shocks (IPCC, 2014). As a consequence, all aspects of food security may be potentially threatened by the effects of

changes in climate, including food availability, access, utilization, and stability (Challinor al, 2010; IPCC, 2014). In this context, livelihood diversification strategies play a crucial role in ensuring food security under climate change, as they have the potential to address two of the Climate-Smart Agriculture (CSA) pillars by contributing to food security and adaptation to climate change.

Livelihood diversification is an important strategy by which rural people can work to combat impacts of climate change (Asravor, 2018). In line with the Sustainable Livelihood framework, a livelihood is defined here as ‘the activities, the assets, and the access that jointly determine the living gained by an individual or household. Ellis (1997) defines livelihood diversification as the process by which rural families construct a diverse portfolio of activities and social support capabilities in their struggle for survival and in order to improve their standards of living. Livelihood diversification refers to attempts by individuals and households to find new ways to raise incomes and reduce environmental risk. This differs sharply by the degree of freedom of choice (to diversify or not), and the reversibility of the outcome (Carter, 1997). Livelihood diversification includes on- farm, off-farm and non-farm activities which are undertaken to generate income additional to that from the main household agricultural activities, this includes the production of other agricultural and non-agricultural goods and services, the sale of waged labour, or self-employment in small firms, and other strategies undertaken to combat impacts of climate change.

Ellis (1999) states that empirical evidence from a variety of different locations suggests that livelihoods diversification is happening. Households in rural areas are engaged in a lot of activities and rely on diversified income portfolios. For instance, in sub-Saharan Africa, about 30–50 per cent reliance on non-farm income sources is common and this may reach 80–90 per cent in southern Africa. In south Asia, about 60 per cent of rural household income comes from non-farm sources. Nonetheless, this varies widely between households that own land and those with access to land for farming. Ellis (1999) states that in sub-Saharan Africa reliance on agriculture tends to diminish continuously as income level rises. The more diverse the income portfolio the better-off is the rural household. There is a common pattern in other areas whereby very poor people and the comparatively well off have the most diverse livelihoods, while the middle ranges of income display less diversity. Ellis (2000) reveals that gender is an integral and inseparable part of rural

livelihoods. Men and women have different assets, access to resources, and opportunities. Women rarely have rights to land, they have lower education due to discriminatory access as children, and their access to productive resources as well as decision-making tend to occur through the mediation of men. Ellis (2000) argues that women typically engage in narrower range of labour markets than men, and lower wage rates. Therefore, diversification is more of an option for rural men than for women. In this regard, diversification can improve household livelihood security and at the same time trapping women in customary roles

Many households in rural areas in third world countries have adopted livelihood strategies as a way of combating the effects of climate change. They do not earn income only from farm sources but rather combine their farming activities with non-farm and off-farm activities (Babatunde and Qaim, 2009). Livelihood diversification among rural households and the factors driving such diversification have captured the attention of development researchers for a long time (Ellis, 1998). This is due to the fact that livelihood diversification is important for food security in rural households (Ellis, 1998, 2000). It is imperative to promote off-farm income opportunities in order to complement farm incomes and to enhance sources of income. Ellis (2000) argues that education is a very important determinant of livelihood diversification. Households that are educated have a much higher likelihood of adopting strategies involving non-farm employment than those that are less or not educated. Many rural households in Ghana consider a secure livelihood as being more important than the desire to maximize income (Norton et al., 1995). Although rural households pursue different types of livelihood strategies, some households are able to access more remunerative strategies than others (Barrett et al., 2005). Certain households depend entirely on their own farm for income, while others are able to source income from a combination of income earning activities. Having a diversified portfolio of income generating activities is considered as one of the ways by which rural households can minimize income variability and to assure a minimum level of income (Alderman and Paxson, 1992). Poorer households are thus expected to have a more diversified income portfolio (Barrett et al., 2001).

According to NCCRS (2010), the southern half of Zambia is prone and vulnerable to drier conditions, and this has adversely impacted on the livelihoods of people. The residents of Siachitema Chiefdom in Kalomo District are vulnerable to impacts of climate change because they

rely on rain-fed agriculture (IPC, 2019). Droughts in this area have a severe and potentially long-term negative impacts on the livelihoods of smallholder farmers by reducing crop yields, affecting natural resources and livestock, this in turn reduces their household incomes. Kalinda et al (2010) elucidate that the people of Kalomo district particularly in Siachitema chiefdom are engaged in small-scale livestock and crop farming as their source of livelihood. Sales of crops and livestock products, as well as vegetables, contribute to local household incomes. However, climate change impacts have caused serious damage to their livelihood due to high dependence on rain-fed agriculture.

Mbewe and Mubanga (2020) conducted a similar study in Chongwe district of Lusaka province. The study focused on smallholder farmer's livelihood diversification as a response to changed climatic patterns. The study concluded that diversification of income through diversified livelihoods would help smallholder farmers enhance their resilience in the face of changed climatic conditions. People in Chongwe adopted particular farming practices which helped them to diversify not just their farming systems, but also their livelihoods. This diversification of livelihood helps to combat climate change impacts and ensure food security. Mseteka (2017) conducted a study in Luangwa on impacts of climate change vulnerability on livelihoods and reports that 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. 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, people in Luangwa district have sought to diversify their traditional livelihood (Agriculture) with non-agricultural activities. Mseteka (2017) states that people 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. As a result of this, the people of Luangwa opted to diversify their livelihoods.

### **1.3 Statement of Problem**

The effects of climate change threaten the livelihood of rain-fed farming communities of Siachitema Chiefdom in Kalomo District. Like the rest of Agro-Ecological Region IIa, Siachitema has been experiencing adverse impacts of climate change, including increased frequency and

severity of intra-seasonal droughts, occasional dry spells, increased temperatures, and general changes in the crop growing season (UNDP, 2018). Climate change is making life more difficult for people of Siachitema mainly due to their dependence on crop farming, livestock and natural resource as sources of livelihoods (Moombe et al, 2019). Further, Moombe et al (2019) reveals that farmers and pastoralists in Siachitema have faced severe income challenges with the continuous reduced harvest. A general decline in maize production which is the major farm produce in Siachitema has been noted in from 2009 and this has continued over the years (Moombe et al, 2019). Further, pastoralists' livelihoods have been negatively impacted by limited water sources for animals, the death of livestock, and the reduction of suitable land for grazing coupled with low quality forage (UNDP, 2018). The effects of climate change have become a hindrance to the sustainability of many livelihoods. Asravor (2018) states that livelihood diversification is acknowledged to have the potential to combat the impacts of climate change and improve climate resilience. Below et al (2010) cited common diversification strategies to withstand climate change effects such as on-farm and non-farm activities. It is in this regard that the study was conducted to assess the extent to which residents of Siachitema area had diversified their livelihoods in order to combat climate change effects and provide recommendations on how diversification can be enhanced to improve food security in Siachitema.

#### **1.4 Aim of the Study**

The aim of this study was to investigate the extent to which livelihood diversification strategies adopted by people in Siachitema Chiefdom have contributed to combating impacts of climate change.

#### **1.5 Objectives of the Study**

- a) To rate the severity of the impacts of climate change on identified livelihood in Siachitema Chiefdom
- b) To assess the livelihood diversification strategies adopted by residents of Siachitema Chiefdom to withstand climate change impacts
- c) To analyze the contribution of livelihood diversification strategies on household food security

## **1.6 Research Questions**

The research sought to answer the following questions:

- a) What livelihoods are common among residents of Siachitema Chiefdom?
- b) How severe are the effects of climate change on local livelihoods in Siachitema Chiefdom?
- c) What livelihood diversification strategies have been adopted by residents of Siachitema Chiefdom to combat effects of climate change?
- d) To what extent do livelihood diversification strategies contribute to household food security?

## **1.7 Research Hypotheses**

The livelihood diversification strategies adopted by residents of Siachitema significantly contributed to combating impacts of climate change.

## **1.8 Significance of the Study**

Climate change and ecological changes have consequently altered life and livelihood-sustaining systems leading to socio-cultural, economic and environmental challenges and vulnerabilities. The risk factors are very high and the effects may raise the developmental impediments of safeguarding livelihood security and poverty eradication in sub-Saharan Africa (Aniah,2019). Livelihood diversification to tackle impacts of climate change is recognized as pressing and necessary. Communities in different regions adopt different livelihood diversification strategies due to the fact that climate change impacts vary from region to region.

The need to conduct this research arose from the fact that Siachitema chiefdom falls in the agro-ecological region IIa which is hard hit with climate change and this has impacts on the livelihood of people. The recurrent droughts in Kalomo district where the chiefdom is located negatively impacts water resources, forests and agriculture which are major source of livelihood for people (UNDP,2018). This has devastating consequences on the people as they become vulnerable and consequently fall into poverty. The information which will come from this study could enable various actors of rural development such as NGOs, Government and International Development

Agencies to come up with appropriate measures and policies to address the impacts of climate change in Zambia. The study might help Non-Governmental Organizations to come up with sustainable livelihood diversification programmes and asset creation projects that are resilience-building programmes. In so doing, people may be able to withstand climate change impacts not only in Siachitema Chiefdom but in other areas as well which are affected by climate change. The study could be cardinal to the government as it may help them to formulate efficient and coordinated policies that may help improve and strengthen the livelihood diversification strategies adopted by people in order to increase resilience of people to impacts of climate change. It might provide an overview of climate change impacts in the country and help government to make policies that support small-scale businesses in vulnerable communities. The findings from this study could help International Development Agencies to know the severity of climate change impacts on local livelihood. Once this is known, it may be easier to make decisions of whether or not to increase and expand their food service programs, and to increase their agriculture services which can help people to combat impacts of climate change. Additionally, information from this study might also be used as literature review and compliment studies which have been conducted already.

### **1.10 Organization of the Dissertation**

This dissertation is composed of six chapters. Chapter one has already provided the background and problem statement. It also outlines the aim, objectives, research questions, significance of the study and research hypotheses. Chapter two reviews existing literature by first showing the conceptual framework and thereafter, a review of livelihood diversification strategies to combat effects of climate change from global, African and Zambian contexts. Chapter three describes the study area (Siachitema Chiefdom) in terms of location, climate, vegetation, topography, soils, and social-economic characteristics with the aid of a map. Lastly, the chapter outlines why Siachitema chiefdom was adopted as the study area.

Chapter four will show the methodology in terms of research design, philosophical position of the study, target population, sampling methods, sample size and sampling procedure, data collection tools and procedure. It will also show methods of data analysis, ethical considerations, reliability, validity, and limitations of the study. Chapter five presents the results and discussion on livelihood

diversification strategies to combat climate change effects mainly in terms of severity of climate change effects, strategies adopted to combat effects of climate change, and their contribution to household food security in Siachitema chiefdom. In chapter six, conclusions and recommendations will be presented. Just after the sixth chapter are the references and the appendix respectively. Introductory chapter (one) above showed the background, problem statement, aim, objectives, research questions, significance of the study, and the research hypothesis. The following chapter (two) will show the review of literature from global, African and Zambian contexts prior to the description of study area in the third chapter

## **CHAPTER TWO: LITERATURE REVIEW**

### **2.1 Introduction**

This chapter will review what scholars have written on livelihood diversification. It will start with theoretical framework and understanding the concept of livelihood diversification, this will be followed by a review of scholarly work from different countries. The review will be narrowed down to the Zambian scenario and policies that emphasize on livelihood diversification in the country will be reviewed.

### **2.2 Conceptual Framework: Sustainable Livelihoods Framework**

The study will employ the sustainable livelihoods conceptual framework. The livelihoods framework is a tool to improve our understanding of livelihoods, particularly the livelihoods of the poor (DFID, 1999). The conceptual framework links well with this study because it clearly brings out factors such as climate shocks, trends, and seasonality that affect the livelihoods of people, especially rural people where this study was conducted. The framework is useful to this study in that it helped the researcher to gauge the effectiveness of the adopted strategies to combat climate change effects. The aforementioned factors are very important in determining rural people's livelihoods (DFID, 1999). For instance, climate change shocks have adverse effects on agriculture in Siachitema and reduce crop yields. Seasonal changes in prices and production can affect rural people. For example, when crop prices reduce on the market, less income is expected for smallholder farmers, subsequently reducing their well-being. The transforming structures and processes play a pivotal role in ensuring that rural people adopt livelihood strategies that lead to a positive outcome. The objectives and research questions of this study were formulated in line with this framework in order to assess the adopted livelihood strategies and their contribution in achieving food security, increased well-being, more income, and reduced vulnerability as outline in the framework below (Figure 1).

According to DFID (1999), the sustainable livelihoods approach is a holistic approach that tries to capture, and provide a means of understanding, the fundamental causes and dimensions of poverty without collapsing the focus onto just a few factors (e.g., economic issues, food security, etc.). In addition, it tries to bring out the relationships between the different aspects (causes, manifestations)

of poverty, allowing for more effective prioritization of action at an operational level. The sustainable livelihoods approach is a way of thinking about the objectives, scope, and priorities for development activities. It is based on evolving thinking about the way the poor and vulnerable live their lives and the importance of policies and institutions (DFID, 1999). The sustainable livelihood approach first seeks to identify the important assets in livelihood, their trends over time and space as well as the nature and impacts of shocks and stresses. The approach puts people at the centre of development. Figure 1 illustrates the Livelihoods Framework.

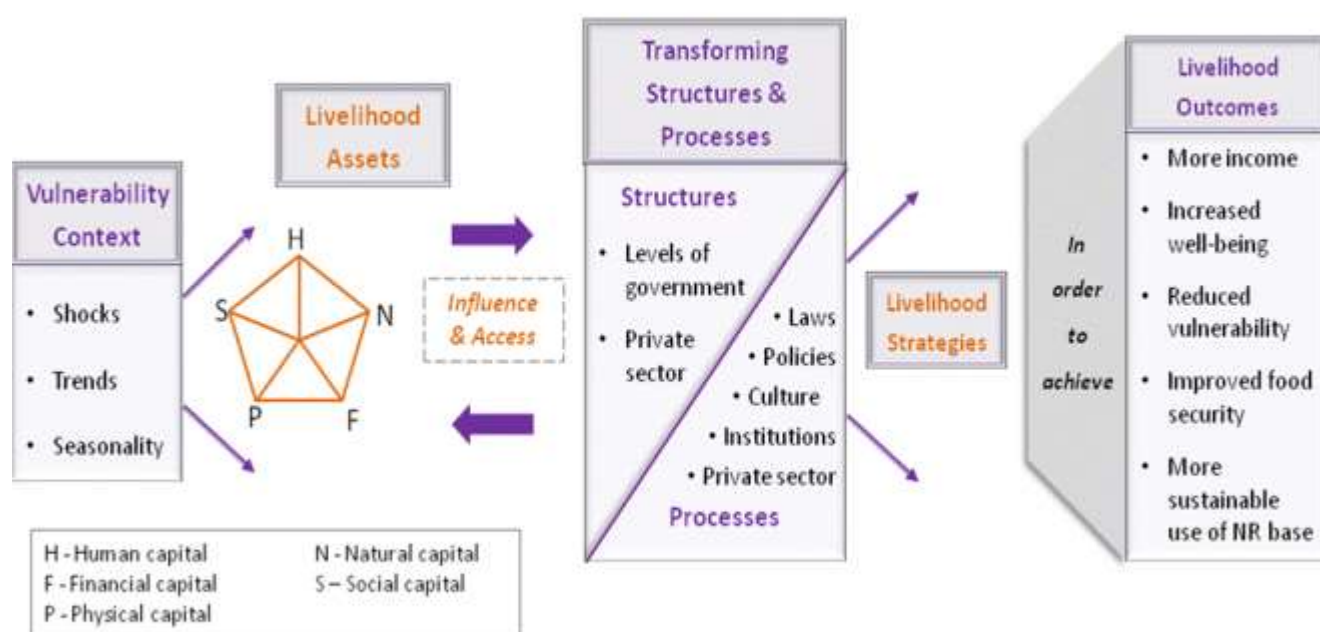


Figure 2. Sustainable Livelihood Analysis Framework (Source: DFID,1999)

DFID (1999) explained that vulnerability context refers to the external environment in which people live. This involves trends like national trends, changes in available technology, the shocks include climatic changes that affect agriculture production, illness or death, conflict, seasonality entails change in prices and the production cycles. The vulnerability context is cardinal as the three factors have a direct effect on the possibilities that poor people have to earn a living every day

(DFID, 1999). Economic conditions can create more or less opportunities and changes in climate can affect crop production. Equally, when a bread winner falls sick, it can deprive a family of an important source of income and this can compel them to sell important assets that they have built up (DFID, 2001). The seasonal shifts in prices, production and employment opportunities equally affect poor people (DFID, 1999).

Further, DFID (1999) explains that the transforming structures and processes box involves institutions and policies which affect poor peoples' lives, these range from public and private entities to national policies and local culture. These can change both the vulnerability context and the assets to that help poor people to have sustainable livelihoods.

The idea of assets is important to the sustainable livelihoods approach, and DFID (1999) states that poverty should not only be perceived from an angle of lack of income, the sustainable livelihoods approach considers the assets that poor people need in order to have a sustainable adequate income to live. Therefore, based on these assets coupled by the vulnerability context and the transforming structures and processes, poor people are able to undertake a range of livelihood strategies, activities and choices that ultimately determine their livelihood outcomes. Poor people combine a variety of strategies in order simply to survive, they may engage in numerous activities and members of a household may live and work in different places so that they make a living (DFID, 1999). The outcomes that they may achieve, all being well, could include more income, increased well-being, reduced vulnerability and greater food security. Sometimes one outcome can negatively affect another; for example, when poor people engage in less risky, and hence lower income activities, in order to be less vulnerable to shocks.

McLeod (2001) explains five types of assets, or capital as they are described in the literature. These are assets that people need in order to make a living. These are as follows; Human capital: this refers to skills, knowledge, the ability to work and good health. Good health is not simply a means to earning a livelihood, it is of course an end in itself. Social capital: the social resources that people draw on to make a living, such as relationships with either more powerful people (vertical connections) or with others like themselves (horizontal connections), or membership of groups or organizations. Generally, relationships of trust, reciprocity and exchange that the poor can draw on in times of need, and that lower the costs of working productively together. Like human capital,

social capital has an intrinsic value; good social relationships are not simply a means, they are an end in themselves (McLeod, 2001). Natural capital: the natural resource stocks that people can draw on for their livelihoods, including land, forests, water, air and so on. Physical capital: the basic infrastructure that people need to make a living, as well as the tools and equipment that they use. For example, transport and communication systems, shelter, water and sanitation systems, and energy. Financial capital: savings, in whichever form, access to financial services, and regular inflows of money. The more assets any household has access to, the less vulnerable they will be to negative effects of the trends and shocks as described above, or to seasonality, and the more secure their livelihood will be. McLeod (2001) states that often increasing one type of capital will lead to an increase in other amounts of capital, for example, as people become educated (increase in human capital) they may get a better job which earns more money (increase in financial capital) which in turn means that they are able to upgrade their home and facilities (increase in physical capital). Sometimes, however, one form of capital decreases as another increases. This could be true, for example, where a person or household sells their land to migrate to a city.

### **2.2.1 Strength of Livelihood Sustainable Framework**

The framework is flexible in its design, open to changes, and it is adaptable to diverse local contexts. The Sustainable Livelihood Approach can serve as an analytical tool in order to identify development priorities and new activities prior to any development activity (Kollmair et al, 2002). Further, the sustainable livelihood analysis (SLA) could be used as a checklist or means of structuring ideas or can be applied in the form of a livelihood analysis to assess how development activities fit in the livelihood of the poor (Kollmair et al., 2002). The core concepts of the sustainable livelihood analysis which is mentioned above represent its strengths at the same time. An important point to note is that it places the main focus on the poor people themselves by involving them in all the planning processes and by respecting their opinions. The poor people themselves define their strength, potentials and goals. This is done by adapting a holistic view to encompass all the aspects of poor people's livelihoods, and by considering that they are dynamic (DFID, 1999). It focuses explicitly on short and long-term changes and allows pointing out the various processes that permanently influence one another. By directly linking problem causes, like for example political programs at a government level, with their effects on individuals, the sustainable framework tries to connect the macro and micro level.

### **2.2.2 Limitations of Livelihood Sustainable Framework**

The conceptual framework has limitations just like other frameworks. A differentiated livelihood analysis requires time as well as financial and human resources (DFID, 1999). Development projects often lack these conditions. Kollmair et al (2002) explains that the idea of being holistic brings a lot of information that is hard to cope with. In addition, when concentrating on improving livelihoods of a particular group, it could negatively affect other livelihoods of people and this can occasion a serious problem. Ashley and Carney (1999) argue that the five asset livelihoods focus too much on the micro-level and neglecting higher levels of governance, policy environment, national and global economic growth. This leads to a limited understanding of how markets operate and how the processes that are far from the lives of poor people have a huge impact on the possibilities that exist for them to earn a secure income (Ashly and Carney, 1999). Ellis (2000) states that the framework is unable to take deep power dynamics and inequalities into consideration even though some dynamics are included.

### **2.3 Understanding the Concept of Livelihood Diversification**

Livelihood diversification is a process by which rural households construct a diverse portfolio of activities and social support capabilities in their struggle for survival and improvement in their standards of living and the means of gaining a living (Ellis, 2000). It can be defined as the maintenance and continuous alteration of highly varied range of activities and occupations to minimize household income variability, reduce the adverse impacts of seasonality, and provide employment or additional income. Livelihood diversification entails both on and off-farm activities (Losch et al, 2013). On-farm diversification means maintaining a wide range of activities in the development of crops and livestock that interlock with each other in different ways. A traditional example is a mixed crop or intercropping which refers to growing two or more crops on the same piece of land to take advantage of complementarities between crops when using soil nutrients, sunlight and other resources (Ellis, 2000). Non-farm diversification refers to finding opportunities for business or jobs other than conventional production of crops and rearing of livestock. The study will be conducted in a rural area where subsistence agriculture has been the main source of livelihood. It is characterized by severe drought, rainfall dependence, poor soil fertility and small farm land that push the rural households to diversify their livelihood strategy

into non-farm income activities. Diversification in rural livelihoods is the subject of conceptual and policy-based research because income from farming has come under pressure due to climate change. The context of various risks implies that households' livelihood diversification is primarily a risk management strategy; both risk adaptation in anticipation of climate change shocks and coping after actual shocks.

## **2.4 Case Studies on Livelihood Diversification**

The life and livelihoods of communities in the world are highly vulnerable to climate change and climate variability (Pritchard et al, 2019). Livelihood diversification of income sources beyond agriculture may be an effective way to tackle the adverse impacts of climate change. Livelihood diversification (LD) plays a pivotal role in fighting climate change shocks and reducing rural poverty in third world countries (Loison, 2019). It is the process of combining both agricultural and non-agricultural activities to survive and combat impacts of climate change (Pritchard et al., 2019). Households across the developing countries are trying to diversify their livelihood activities to secure from risks and cope with climate shocks (Martin and Lorenzen, 2016). By providing alternative non-farm job opportunities, livelihood diversification marks a vital role in sustainable ecological development and rural poverty reduction (Liu and Lan, 2015). Climate change has emerged as a threat to natural life and livelihood systems (Rahman et al, 2018).

### **2.4.1 Livelihood Diversification to Combat Climate Change Impacts in Indo-Gangetic Plain**

The Indo-Gangetic Plains (IGP), a bread basket for much of South Asia, is considered to be highly vulnerable to climate change because of its large population, a largely agrarian economy, a relatively limited and depleting resource base, and projected large changes in climatic risks (Aggarwal et al., 2004). The changing climate is exacerbating existing vulnerabilities of subsistence farming that predominates in many parts of IGP (Nelson et al., 2009; IPCC, 2007). Climate-related issues and people's livelihood strategies are diverse in different parts of indo-gangetic plains. A lot people in Nepal and north east India suffer from droughts and sporadic floods whereas coastal Bangladesh is a hotspot of climate change (Nicholls et al., 2007). In trying to overcome some of the climatic challenges, households have diversified their livelihood sources (Brown et al, 2006). Several researchers (Barrett et al., 2006; Barrett and Reardon, 2001) offer the reason that farm households follow agricultural diversification as a prominent livelihood

diversification strategy under uncertainty caused by climatic and non-climatic factors. Diversification on the farm and off-farm determine the strength of livelihood strategies households follow (Hailu and Hasan, 2012); the larger the diversification portfolio on the farm and off-farm, the more successful people are in combating climate change impacts which in turn ensures household food security.

Gopal et al (2015) conducted a household study in three broader sub regions (Bihar of India, coastal Bangladesh and Terai of Nepal) in Indo-Gangetic Plains on livelihood diversification and climate change adaptation. People get their livelihoods through a variety of on-farm activities. Majority of the households in the studied sub-regions predominantly pursue agriculture-based livelihood strategies through intensification and diversification. In Bihar and Terai of Nepal, a majority of the farmers get their livelihoods through food crops whereas livestock including fisheries is an important on-farm livelihood source in coastal Bangladesh. However, recurrent droughts and sporadic floods often force the inhabitants of these regions to pursue off-farm livelihood strategies to combat impacts of climate change and amass cash for present and future security (Gopal et al, 2015). Off-farm sources of livelihoods in indo-gangetic plain are manifold: wage earning from commercial farms which use irrigation to support growth of crops, employment in several sectors, remittances, credit/loan and business, among others. These off-farm sources of income help people to complement agricultural activities which are severely affected by climate change. In Bihar, a large proportion of the households are engaged in wage earning either in others' farm and/or in other non-farm sectors, followed by employment in different sectors. People in the coastal Bangladesh are also mostly engaged in wage earning followed by pursuing credit/loans from formal and informal sectors. In Nepal's Terai, a large proportion of people are deriving income through employment followed by the wage-earning activities. In Bihar and Nepal's Terai, remittance accounts the third important source of off-farm livelihoods while business provides a third off-farm source to the farmers in the coastal Bangladesh (Gopal et al, 2015).

## **2.4.2 Livelihood Diversification to Combat Climate Change Impacts in Bosnia and Herzegovina**

Bosnia and Herzegovina is considered highly vulnerable to climate change (Ognjen and Pal Olav, 2019). Extreme weather events, such as increased intensity of droughts, frequency of heat waves, and heavy precipitation resulting in floods and landslides, are increasingly occurring and have already caused significant economic losses and environmental degradation. There is a limited adaptive capacity to cope with both climate and other shocks in BH. The situation is actually similar to that found in many developing countries (Zurovec, Cadro, Sitaula, 2017). This inherently low adaptive capacity is the main determinant of vulnerability to climate change in most rural areas of Bosnia Herzegovina, even more so than the degree to which these areas are defacto exposed to significant climatic variations. Livelihood diversification include changes in crop and livestock management practices, land use and land management, and a variety of both on-farm and off-/non-farm combined or diversified livelihood strategies (Ognjen and Pal Olav, 2019). While climate change has yet to be mainstreamed into national and regional development policies in BH, individuals and communities are already diversifying their livelihoods to thwart impacts of climate change. Such adaptation strategies are mostly reactive and carried out in response to perceived and experienced adverse impacts of climate change and variability. Non-farm activities are important contributor to household incomes (18.5%). The reported non-farm incomes come from a variety of formal and informal employment (Ognjen and Pal Olav, 2019). Off-farm, non-agricultural incomes do not constitute a significant percentage of overall total incomes in our case, but still represent a significant source of income for some individual households. The most common off-farm non-agricultural incomes are services, which some household members offer with their on-farm tools, such as mechanical workshops, carpentry, welding, tractors, transport trucks, bulldozers, logging, and alcohol distilleries. Remittances (2.7%) are mainly received from family members and relatives living in urban areas or abroad. Although the average incomes received from pensions and other social transfers are quite low in BH, households may have overlooked their importance in the total household income (Olsson et al, 2014).

### **2.4.3 Livelihood Diversification to Combat Climate Change Impacts in Mexico**

Climate change in Mexico is expected to have widespread impacts on Mexico, with significant decreases in precipitation and increases in temperatures (Mercer, Parales and Wainwright, 2012). This will put pressure on the economy, people and the biodiversity of many parts of the country, which have largely arid or hot climates. Already climate change has impacted agriculture, biodiversity, farmer livelihoods, and migration, as well as "water, health, air pollution, traffic disruption from floods, and housing vulnerability to landslide. Rural households draw on an array of strategies to tackle climate change impacts, such as productive livelihood diversification, migration, and intensifying production, all while facing a broad range of risks (Ellis, 2000). Diversification is a fundamental strategy for rural households (Alobo, 2015). In Mexico, between 20% and 30% of jobs are non-agricultural and account for 40% of rural income (Reardon et al., 2001). Although this figure may vary depending on the context or household assets (Morse, McNamara and Acholo, 2009). Mexico has a remarkable record of addressing climate change challenges and is considered a global leader in the topic. The country's comprehensive strategy for climate resilient and low carbon economic growth is one of the most active in the world. Driven in part by the country's vulnerability to climate impacts, the Mexican Government has shown its commitment, long-term vision, and political will to addressing climate change and helping its people to ameliorate impacts of climate change through its policies and its active role in global climate forums.

People have diversified their livelihoods to withstand climate shocks by engaging in non-farming activities to earn income, fundamentally from temporary jobs in construction, transportation, and retail (Israel and Ávila-Foucat, 2017). The households in this group travel on a daily basis to the communities where they work in nearby towns. Others are engaged in business and the little they earn is used to purchase food and other basic needs. Programs such as the Savings and Credit Sector Strengthening Program implemented by the National Savings and Financial Services Bank (BANSEFI) with support of the World Bank provided investment lending, development policy loans, grants, rural credit enhancement to help people start up business as a livelihood diversification strategy (Israel and Ávila-Foucat, 2017). Households with a greater share of non-agriculture income are close to regional development hubs, giving them greater job opportunities,

while smallholder farmers, who are more reliant on natural resources, are more isolated. Thus, livelihood diversification is tied to proximity to cities and access to regional labor markets. Likewise, all rural households have suffered climate-related damage, due to hurricanes and droughts. Diversification is a major strategy that households use, and sectoral policies have tended to support productive activities, but they are not consistent with each other. Accordingly, in order to support livelihood diversification, it would be necessary to have an efficient and coordinated policy that considers sustainable development (Isael and Avila-Foucat, 2017).

#### **2.4.4 Livelihood Diversification to Combat Climate Change Impacts in Africa**

Severe climatic events such as droughts, floods, and extreme temperatures are expected to increase in frequency and intensity over time in Africa (Nelson and van der Mensbrugghe, 2013; IPCC, 2012). In the absence of measures to reduce the vulnerability of people to these events, significant negative impacts on food security are expected (FAO, 2010). Households throughout sub-Saharan Africa are particularly exposed to climate induced risks, due to the preponderance of rain-fed production systems and imperfect market conditions. Climate change exacerbates these risks by increasing the probability and severity of adverse weather conditions. Extreme weather events may directly affect agricultural productivity in terms of crops, livestock, fisheries and forestry, and affect incomes indirectly through decreased labour demand, increased local prices, as well as limited access to markets due to different constraints such as, negative impacts on infrastructure. Hence, climate change not only represents a threat to incomes today, but also makes them less predictable by changing the incomes' probability distributions in ways that are difficult for households to incorporate into decision-making (Lipper and Thornton, 2014). An effective way of withstanding climate change impacts and reducing vulnerability and smooth risk is through adoption of diversified livelihood strategies. Different livelihood diversification strategies have been adopted by households in Africa to manage climate change impacts and generate income (Arslan et al, 2017). The ability of a livelihood system to respond to shocks through coping strategies is indeed a crucial determinant of household resilience. Diversifying livelihoods is a continual adaptive process for households to add new activities and to continue existing ones or drop others, thus maintaining diverse and changing livelihood portfolios. Diversification helps to reduce climate change impacts, especially those related to seasonality in rain-fed agriculture. It

can also be part of a strategy of combining (sequentially or in parallel) activities that contribute to the accumulation of wealth at different points in the household life cycle (Deshingkar, 2004). This diversity of income sources prevails across different income classes, but the nature differs between better-off and poorer households. The better off tend to diversify in non-farm business activities (trade, transport, shop keeping, brick making) or salaried employment. The poor tend to diversify in casual wage work, especially on other agricultural production units, while remaining heavily reliant on subsistence crop production. Diversification by the poor thus tends to leave them highly reliant on agriculture; that by the better off reduces this reliance. Becoming less dependent on agricultural production is part of becoming better off. The poor and the better off may diversify to the same degree, but the absolute non-farm income of the better off is several times better than that of the poor (Deshingkar, 2004).

#### **2.4.5 Livelihood Diversification to Combat Impacts of Climate Change in Tanzania**

Tanzania has witnessed a number of climate related disasters such as flooding, droughts, widespread crop failures, loss of livestock and intensification of climate sensitive diseases among others (Caven and Anne, 2010). Certain areas of the country such as the inner parts are likely to experience higher increase in temperature than coastal areas, the cold and dry seasons will be warmer more than warm and wet seasons. Rainfall is predicted to decrease by 20 percent in the inner parts of the country. However, rainfall may increase by 25-50 percent in the northeast, southeast and the Lake Victoria basin. Changes in the mean temperature, rainfall patterns and rainfall variability are likely to prolong dry seasons and may increase the severity of periodic droughts. The poor, usually with limited resources and who contribute the least to the causes of climate change are the most affected in many ways (Caven and Anne, 2010). The effects of climate change in the country are widespread and significantly interfere with agriculture which is the major source of livelihood for people, while at the same time, reducing the ability of the society to deliver services. Paavola (2004) conducted a study on livelihood, vulnerability and adaptation to climate change in Morogoro region. The study focused on how people in the region responded to draughts by diversifying their livelihood. Pavoola states that responses to climate change impacts involve attempts to reduce dependence from agricultural production. In Morogoro, non-farm income has become consistently more important as a livelihood diversification strategy since the mid-1980s and it has compensated for the decline in farming. Many households turn to natural resources in

order to cater for their subsistence needs and to earn cash income. For instance, forests provide timber, firewood, fruits, spices, fodder, traditional medicines and meat for subsistence needs. People harvest trees for the production of timber and charcoal for local and more remote markets and the fuel wood obtained from the forests is used for energy-intensive production of bricks. Monela et al (2000) is of the view that households in Morogoro and Dodoma regions obtain up to 68 percent of their total income from forests. The role of natural resources was the greatest in peri-urban communities which have access to urban markets for forest products such as charcoal and firewood. Forest products contributed about 50 percent of total income also in the more remote communities. The results of these studies are in line with those obtained in other parts of Tanzania. For example, Meshack (2006) reports that households obtain at least a third of their total income from forests in the West Usambaras in northern Tanzania.

#### **2.4.6 Livelihood Diversification to Combat Impacts of Climate Change in Ghana**

Historical data for Ghana from the year 1961 to 2000 clearly shows a progressive rise in temperature and decrease in mean annual rainfall in all the six agro-ecological zones in the country. Climate change is manifested in Ghana through; rising temperatures; declining rainfall totals and increased variability; rising sea levels; and high incidence of weather extremes and disasters. The average annual temperature has increased 1°C in the last 30 years (Minia et al, 2004). Based on this data, Minia et al (2004) estimate that temperature will continue to rise, while rainfall is also predicted to decrease in all agro-ecological zones. In all agro-ecological zones average annual temperatures are estimated to increase between 0.8°C and 5.4°C for the years 2020 and 2080 respectively. Within the same period average annual rainfall total is estimated to decline by between 1.1%, and 20.5%. The major challenges in all zones are weather extremes such as flooding, droughts and high temperatures. In the Transitional zone, the projected trends that are most likely to pose the major problem are the early termination of rainfall which is likely to convert the current bi-modal regime to a uni-modal one. Historical analysis by Owusu and Waylen (2008) has indicated that, rainfall variability may be the single largest component of rainfall changes affecting all agro-ecological zones in Ghana. In the Transition zone for instance, the short dry spell (July and August) which is crucial for preparing the land for the second crop is increasingly becoming wetter and the short rainy season terminating early. The available empirical evidence in Ghana unequivocally indicates the existence of a large and growing livelihood diversification to

combat impacts of climate change among subsistence farm households (Lay and Schüler, 2008). Senadza (2014) argues that many rural farm households are much interested in securing their livelihoods than maximize farm income hence the increase livelihood diversification strategies. Even among farm households in Ghana, rural Northern Ghana is moderately diversified, although it is the most vulnerable to climate change and has the highest poverty levels. Additionally, Northern Ghana has a single raining season, the lowest average rainfall of between 800 and 1100 mm per annum and the highest temperature of 43°C. Any failure in the rains adversely affects the livelihood of smallholder farmers and plunge them further into poverty. Livelihood diversification in that part of Ghana is, therefore, attributable to push factors rather than pull factors (Senadza, 2014).

As a better and reliable way of withstanding climate change impacts, many households diversify off the farm by supplying their labour to the non-farm sector. Owusu et al. (2011) opined that diversification into the non-farm sector exerts a positive and statistically significant effect on household income and food security status. Thus, the non-farm sector is an unquestionable means of securing income because climate change has led to lower crop yields and increasing crop failure which has further worsen the plight of smallholder farmers (Laube, Schraven, and Awo, 2012). The rural non-farm sector of Ghana can be classified into the wage employment sector and self-employment sector or own enterprise operations (Antwi-Agyei et al, 2014). The wage-employment sector of rural Ghana involves households supplying their labour for daily wage, what is popularly called 'By-Day,' whilst the self-employment sector involves household operating their own businesses usually on a 'table-top' or in a small kiosk. National figures from the Ghana Statistical Service also indicate that 46 per cent (3 million) of all rural households in Ghana operate or own a non-farm enterprise, with women operating 72 per cent of these business ventures. Women in rural Ghana especially Northern Ghana are usually found in the agro-processing businesses. Thus, women process groundnuts, shea nuts, cotton ginnery, rice and trade food stuff, whereas men often engaged in transportation services, repair services and temporal migration to the South in search of blue color job (Ackah, 2013). Another common form of livelihood diversification strategy in rural Ghana is migration. Migration into the big cities or taking up more local non-farm employment is essential for the rural household due to the income generated. Many rural households migrate to the big cities during the dry season, when there is virtually no farming.

#### **2.4.7 Livelihood Diversification to Combat Climate Change Impacts in Zambia**

Livelihood diversification strategies are implemented by households in rural environments as a response to climate change impacts and opportunities to manage risk and increase or stabilize income and consumption (Romdhani et al, 2018). Most households in rural Zambia rely on rain-fed agriculture for their livelihoods and, as such, are highly dependent on climatic conditions. Livelihood diversification is regularly identified as a key adaptation option given the current socioeconomic state of Zambian populations and communities and the current and projected impacts of climate change (Romdhani et al, 2018). The dominant discourse around adaptation and diversification in Zambia is focused on agriculture-based livelihoods, which are facing the greatest risks from climate change. Currently, in response, adaptation and diversification interventions are focused on transitions to (and between) different forms of conservation agriculture, crop diversification, and a combination of farm and non-farm activities such as seasonal fishing and charcoal production (Loison 2015; Romdhani et al. 2018).

Mubanga and Mbewe (2020) conducted a similar study and stated that smallholder farmers have used crop rotation, intercropping, changed maize varieties and legume technologies as a way of adapting to climate change. Intercropping some crops with maize allows farmers to diversify their crops to include drought tolerant ones. What this means is that even when the maize does not do well due to its high sensitivity to climatic changes, other crops may enable farmers to be food secure. Additionally, when maize is intercropped with legumes, the legume helps in improving soil fertility. At the same time, the legume is not only used as a food crop by farmers, but also a cash crop which helps to improve farmers' household economic status. The fact that crops intercropped with maize can be used as cash crops as well as food crops, provide a coping strategy for smallholder farmers against impacts of climate change, when the staple crop maize yields falters (Mubanga and Mbewe, 2020). In trying to adapt to climatic changes, farmers have opted to planting early maturing maize varieties, as an adaptation to changed climatic conditions, because this type of maize variety does not require a long growing season. Hence, when encountered with the perceived reduced growing season, farmers who plant early maturing crop varieties are not adversely affected. that smallholder farmers can possibly generate higher returns from off-farm livelihoods as was the case for farmers engaged in casual work who generated over three times

more than they did from engaging in on-farm activities. Furthermore, Mubanga and Mbewe (2020) are of the view that smallholder farmers could be better placed to adapt to changed climatic patterns if they diversified their livelihoods to include those, they may have a competitive advantage in and which had low risk and uncertainty. This could imply engaging in both on-farm and off-farm activities, with a higher concentration on the livelihoods that could be more sustainable at particular times. The study conducted by Mubanga and Mbewe (2020) provide insight into how smallholder farmers could sustainably adapt to the impacts of climate change by, Planting of drought resistant varieties of crops. Farmers in Chongwe district have resorted to planting early maturing maize seed varieties which do not require a long growing season, use of sustainable farming systems: Some smallholder farmers in Chongwe had adopted the potholing farming system as a way of preparing their fields in readiness for planting. Potholing was used as an adaptation technique to reduced rainfall because the holes dug, stored water when it rains making the moisture available to plants longer than in ploughed fields, Gardening: Gardening is important as one of the livelihood activities (Mubanga and Mbewe, 2020). It saves income as farmers may not need to buy every vegetable, onions or tomatoes they need. Besides, if gardening is used as an off-season livelihood when farmers are not cultivating the fields it ensures a constant flow of income to households even when income from on-farm livelihoods has dried, intensify engagement in Off-farm livelihood activities: During periods of extreme climatic conditions, crop production becomes a challenge as a result, farmers do not harvest enough to sell and acquire enough income to sustain themselves (Mubanga and Mbewe, 2020). Intensifying engagement in off-farm livelihoods, provide smallholder farmers with insurance during the periods of reduced farm productivity. Maintaining off-farm income resources also help farmers to cope and rebuild their farm-based livelihoods after an extreme event. Diversification into off-farm livelihoods is not only a critical short term coping strategy, it is also critical for the resilience of agricultural livelihoods themselves.

## **2.5 Review of Policies with Implications on Livelihood Diversification in Zambia**

The policies put much emphasis on agriculture diversification in order to increase income, ensure food and nutrition security. Diversification can occur in different forms, including genetic diversity in monocultures, field diversity with non-crop vegetation, crop rotations, mixed farming, polycultures and agroforestry (Lin, 2011). In Zambia, agricultural diversification is defined in the Second National Agriculture Policy (2016) as a shift away from dominance by one crop to include livestock and fisheries production. Crop diversification is referred to as a shift to the production of a number of crops. Other definitions from outside Zambia broaden this idea to an increase in the number of varieties that are grown, and taking into account how land is allocated among those crops and varieties (Aberman et al, 2015).

### **2.5.1 8th National Development Plan 2022-2026**

The Eighth National Development Plan (8NDP) sets out Zambia's strategic direction, development priorities and implementation strategies for the period 2022 to 2026. This Plan is a successor to the Seventh National Development Plan (7NDP) that was implemented over the period 2017 to 2021. The Government through its 8th national development plan will promote farm block development with special focus on diversification of crops and expansion of the livestock and fisheries sub sectors. The farm block concept entails the creation of specialized agricultural production and processing zones. Livestock production will be enhanced through establishing community-managed livestock service centres, provincial livestock insemination centres and veterinary laboratories. The Government will also devolve veterinary services to improve efficiency in the livestock sub-sector. This will encourage smallholder farmers to invest more in livestock farming. There will also be interventions in fisheries that will aim at promoting investments for increased fingerling production and establishing and operationalizing fish breeding and freezing centres. The 8NDP prioritizes measures aimed at enhancing climate change mitigation and adaptation as well as strengthening disaster risk reduction.

### **2.5.2 The 7<sup>th</sup> National Development Plan of 2017-2021**

The Government of Zambia, through its 7th National Development Plan (7NDP), expresses the aspirations of the Zambian people for the country to become a prosperous middle-income nation

by the year 2030. The 7NDP provides a foundation for diversification. It contains a specific strategy on promoting livelihood diversification within the agriculture sector. It puts emphasis on diversification in crops, fisheries, livestock and forestry products based on the comparative and competitive advantage of each product and agro ecological zone (GRZ, 2017). The focus is on improving production of high-value exports, such as cashew nuts, coffee, maize, wheat, tea, cotton, sugar, fish, and agroforestry and livestock products. The 7NDP also includes a strategy to enhance food security and nutrition through the promotion of nutritious foods and household food security (GRZ, 2017). The revival of the fruit processing industry was identified as one of the quick wins for the accelerated creation of jobs and livelihood diversification. Revival of fruit processing industry would encourage small-holder households to diversify their livelihoods into horticulture industry as this would increase their income. The policy promotes conservation agriculture as one of the main strategies for crop diversification, since one of conservation agriculture's pillars is crop rotation with legumes. The Rural Agriculture Livelihood Survey (2015) report showed that 61% of farming households cultivated maize with a leguminous crop (groundnuts, velvet beans mixed beans, cowpeas or soybean). The level of crop diversification varies widely across Zambia, with the north and north-eastern provinces being more diversified than the other provinces.

### **2.5.3 Second National Agriculture Policy of 2016-2020**

The Second National Agricultural Policy (SNAP) is based upon the guiding principle of the right to adequate and nutritious food and contains an entire strategic objective of improving food and nutrition security through diversification. (MoA, 2016). The policy aims to promote crop diversification through direct measures, as well as through some of the drivers of crop diversification (e.g., improving agricultural extension services). The policy also puts emphasis on livelihood diversification from crop dominance to include livestock and fisheries production so as to improve food and nutrition security. In this policy people are encouraged to venture into livestock farming as it plays several socioeconomic roles, including being an important livelihood source for rural smallholder farm households. It is estimated that 1,151,393 smallholder households support their livelihoods through raising at least one type of livestock. The policy encourages more smallholder households to take this path in order to increase their income and combat climate change impacts. However, unlike the 7NDP, the SNAP does not make specific

reference to reviving the horticulture or fruit sector. This could negatively affect households that would want to diversify into the aforementioned sector.

#### **2.5.4 Farmer Input Support Programme**

FISP was introduced in the 2009-2010 farming season, it was transformed from the Farmer Support Programme (FSP). The Farmer Input Support Programme (FISP) has been the mainstay of Zambia's food basket. This has to continue to ensure food security in the country. Under FISP, Government distributes subsidized agricultural farming inputs to small-scale producers of maize, the country's staple food crop. FISP has continued to dominate the agricultural sector because of the significant role small-scale farmer's play in beefing up Zambia's strategic food reserves. Zambia's agriculture sector has continued being robust as a direct result of the robust FISP programme. The FISP programme is implemented through a flexible e-voucher programme to promote agricultural diversification and crowd-in private sector input distribution. This innovation is expected to promote agricultural diversification by empowering beneficiary farmers to: purchase inputs of their choice at their nearest input outlets; ensure timely access to inputs by smallholder farmers. The Farmer Input Support Program (FISP) Electronic Voucher initiative opens a window of opportunity for smallholder farmers to diversify their farming enterprises. The policy has widened the choice of inputs for farmers engaged in both crops and livestock rearing. Under the conventional FISP, government distributes only seed and fertilizer, but in this case farmers will be buying what they require. Those in livestock can purchase feed while others can get farming implements. This will enable households diversify their livelihood sources and increase income. Apart from improving beneficiary targeting and promoting timely access to inputs by increasing private sector participation, the 'E-voucher' programme has the potential to accelerate diversification of the smallholder sector by allowing farmers to purchase a wide range of recommended inputs such as veterinary drugs, agricultural equipment, livestock, poultry and fingerlings. Under FISP, smallholder households are able to purchase cattle from approved agro dealers through the E-voucher subsidy. Investing in cattle production is more sustainable and profitable than growing maize because it has two production circles. People also get milk as an extra source of income. FISP also provides opportunities for households to buy vegetable seeds and this goes a long way in promoting livelihood diversification. People venture in gardening and sell vegetables to generate income which they use to buy basic needs.

Additionally, smallholder households can acquire variety of drought tolerant seeds from FISP such as cowpeas which they can grow in times of drought. This ensures food and nutrition security even in times of prolonged droughts.

### **2.5.5 National Policy on Climate Change of 2016**

On the 3rd of March 2017, Zambia finally launched the long-awaited National Climate Change Policy aimed at stemming the impact of climate change and subsequent reduction of the country's annual economic growth due to crop failure and the impact of climate change on energy production. The National Climate Change Policy is an important policy development that introduces a well-structured and coordinated national strategy to effectively tackle the adverse effects of climate change. The policy also provides the country with home grown initiatives targeted at minimizing the impact of climate change on national development. The policy emphasizes landscape-based livelihood diversification in order to combat climate change impacts. It includes support for improved rural livelihood options such as vegetable gardens and other types of climate-smart agriculture, solar boreholes for increased water access, gardens and livestock, and basket weaving. The policy supports various projects aimed at diversifying the livelihoods of communities and make them resilient to climate change. The Nakonga Mushroom Project is a clear example of how National Policy on Climate Change supports livelihood diversification. The Nakonga Mushroom Project in Sefula, Mongu District, approved in 2017, contributed US\$7,000 (ZMK83, 000) for the purchase of mushroom spores (seeds), a refrigerator, a solar panel, and a production building. The mushrooms are grown in a medium of sterilized (cooked) rice straw and/or elephant grass, both locally available. Members of the community have learnt how to grow mushrooms, a crop specifically chosen because it does not rely on rainfall. Sales of the mushrooms following the 21-day cycle have been good, and local schools have purchased a considerable portion for their student-feeding program (Global Delivery Initiative 2018). The community group is exploring how to add value to the mushrooms through preservation and packaging, and how to support sustainability with reliable year-round markets and improved infrastructure. However, it will take time for the project to provide a reliable alternative source of livelihood due to the large number of beneficiaries. On a brighter note, understanding climate change impacts has increased the community's determination to develop a sustainable alternative livelihood based in farming.

There is also emphasis in the policy to diversify into livestock farming and this is due to the fact that livestock production provides opportunities for communities to adopt alternative livelihoods that reduce their vulnerability to climate shocks

## **2.6 Research Gap**

The reviewed literature above has exhibited some of the ways in which people have diversified their livelihoods in order to withstand climate change. There is a wide consensus from reviewed literature that droughts, floods and high temperatures are the climate change shocks that affect the livelihoods of households. Further, the review from literature has shown that agriculture which is the major source of livelihood for the rural people of Zambia is the most affected sector (UNDP, 2018). However, literature has not shown whether or not the livelihood diversification strategies adopted by people in rural areas have contributed to combating effects of climate change. The reviewed literature has not shown whether or not the livelihood diversification strategies contribute to household food security. So, this study will endeavor to fill this literature gap by addressing and answering research questions. It is strongly believed that the study may contribute immensely to the literature on this topic and help key drivers of rural development make informed decisions and formulate appropriate policies to improve people's resilience to climate change.

## **CHAPTER THREE: DESCRIPTION OF STUDY AREA**

### **3.1 Introduction**

This chapter describes the study area. It will describe the socio-economic characteristics, climate, topography, soils and vegetation of the study area. The economic and physical characteristics have been included in this study to help the readership know the type of area where the study was conducted. The chapter will also show reasons for adopting Siachitema Chiefdom as study area.

### **3.2 Location**

Siachitema Chiefdom is located in the north of Kalomo District, in the Southern Province of Zambia. It lies on latitude 16.74 South, Longitude 26.43 East and Altitude 1319 m. The Chiefdom shares boundary with Kalomo town. The Chiefdom is located in the north of Kalomo Central Business District and the distance from the CBD to where the Chiefdom starts is 4 kms. Siachitema is located in the South of Lusaka, the capital city and the distance is 338 kms.

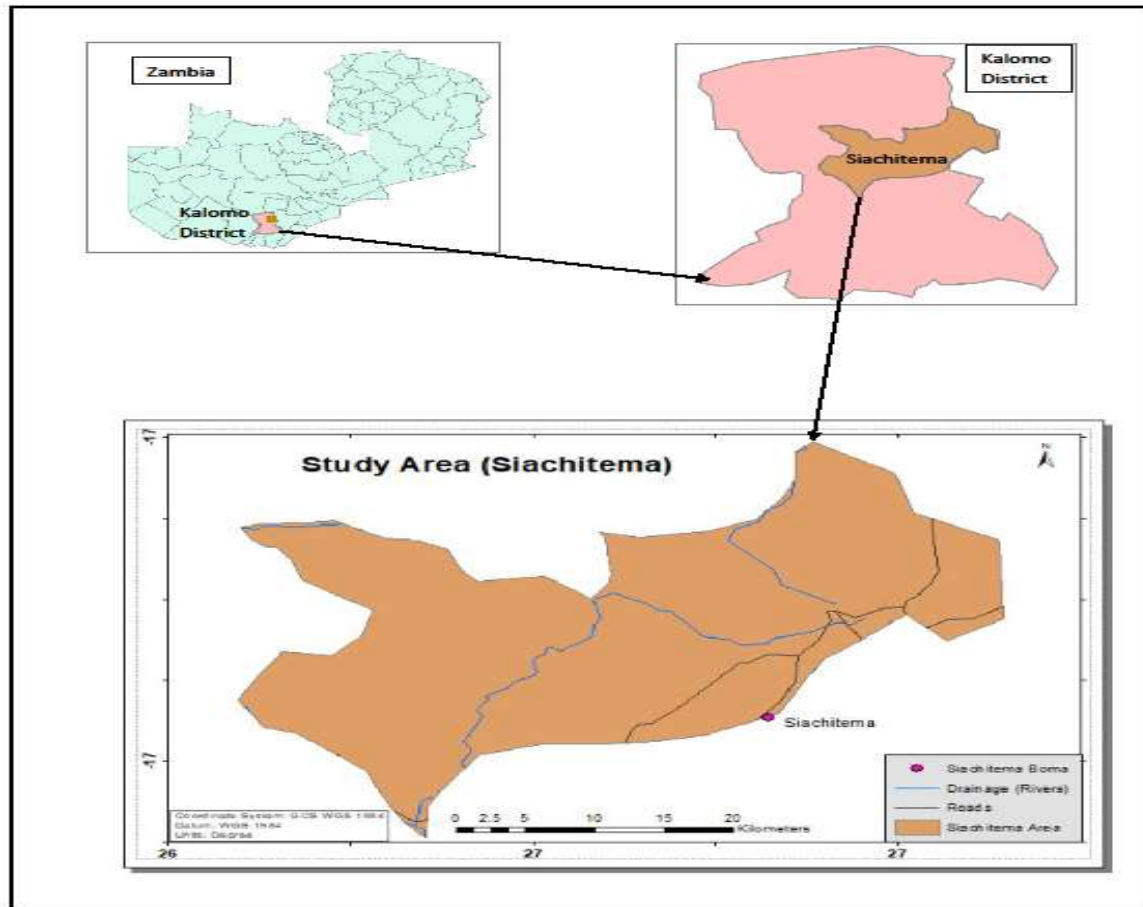


Figure 3. Map of study area (Source: UNZA Geography Department)

### 3.3 Climate

Siachitema is located in agro-ecological region II of Zambia and on the Tonga Plateau. As such, the area experiences four distinct seasons; cold and dry (May-August), hot and dry (September-November), warm and wet (December-February) and cold and wet season (March-April (GRZ, 2004). The chiefdom is in one of the coolest districts in Zambia with a mean annual temperature of 20 °C. The temperature ranges from as low as 2 °C to as high as 40 °C in the warm wet season. Rainfall is highly variable, ranging between 800 and 1200 mm in the higher altitude areas and < 800 mm in some lower parts (GRZ 2004; Kalinda et al 2010; Somanje et al 2017; KTC 2018). November-March/April is the rainy season. (Roberts, 1976). However, intra-seasonal droughts and

dry spells over the period of December-March/April is now commonplace. The extent to which these climatic changes have affected livelihoods and food production has been severe.

### **3.4 Vegetation, Topography and Soils**

Siachitema Chiefdom is covered by vegetation associated with dry forests and woodlands. The most prominent vegetation type is miombo forest which is dominated by trees from the genera *Brachystegia*, *Julbernardia*, *Isobertia* and other leguminous trees with a well-developed grass layer. The woodland has undergone significant transformation in the last three decades. Most Miombo forest is secondary regrowth because of extensive cultivation in the past. Miombo woodlands have invaded into the Kalahari, forming Miombo/Kalahari woodlands (Bäumle et al, 2007; Mbanga et al, 2019). The Chiefdom lies on a high plateau, referred to as the Batoka or Tonga Plateau at an altitude of between 1220 and 1830 meters above sea level (Fagan 1963; Roberts 1988), consisting of a soft undulating plain with a peak at its center. The chiefdom has sandy loam soils with scattered Kalahari sands and clay loam (KTC, 2018)

### **3.5 Social-Economic Context**

Siachitema Chiefdom is inhabited by the Tonga speaking people, although some parts of the chiefdom consist of early white farmer settlers. The Tonga people settled in the area in the early 17th century (Cliggett, 2000). The history of the settlement patterns of the Tonga people of Siachitema in Kalomo District is similar to the rest of Southern Province. They started as a society preyed on by powerful African neighbors such as the Lozi and Ndebele tribes who coveted their cattle during the mid-1800s. In response, they developed a highly dispersed pattern of settlement, which was easier to defend (Roberts, 1976). At that time, the Tonga villages were a collection of huts spread over many kilometers and very few significantly large clusters developed. Tonga people also contended with early colonialism. The arrival of European foreign influence further disrupted the spatial organization of settlements on the Tonga Plateau, disturbing the indigenous economy and introducing urbanization (Nchito, 2013).

The Chiefdom and Kalomo District as a whole is referred to as the ‘Farmer’s Nest’ because of the commercial, medium- to small-scale livestock and crop farming enterprises that exist there. Sales of crops, livestock products, as well as fruits and vegetables, contribute to local household

incomes. Crop production in the district is carried out at subsistence level, complemented by limited semi-commercial and commercial farming. Major crops grown are maize (*Zea mays*), groundnuts (*Arachis hypogaea*), cotton (*Gossypium hirsutum*), tobacco (*Nicotiana tabacum*), sunflowers (*Helianthus annuus*), cowpeas (*Vigna unguiculata*), sweet potatoes (*Ipomoea batatas*), wheat (*Triticum aestivum*), soybeans (*Glycine max*) and various vegetables (Kalinda et al. 2010; KTC, 2018). Maize is the primary staple crop and occupies 61% of the cultivated area. Both landraces and hybrid maize varieties are cultivated.

### **3.6 Reasons for Adopting Siachitema Chiefdom as a Study Area**

Siachitema Chiefdom was selected for the study because it was located in a province and district which was hit hard with impacts of climate change. The area was located in the agro-ecological region IIa where dry spells were common and reduced crop yields (Chikowo, 2013). According to Zambia Daily Mail 3<sup>rd</sup> June (2018), Siachitema Chiefdom recorded a poor crop harvest during the 2017/2018 crop marketing season because of the drought experienced in the area. The dry spell which hit the chiefdom at the planting stage caused a devastating effect on the maize fields and other weather sensitive crops. The Zambia Daily Mail of 3<sup>rd</sup> June 2018 reported that “Chief Siachitema of Dundumwezi Constituency in Kalomo district in Southern Province called on government to consider sending relief food to his chiefdom following a drought experienced in the area”. It is for these reasons that the Chiefdom was selected for the study.

## **CHAPTER FOUR: METHODOLOGY**

### **4.1 Introduction**

This chapter presents the methodology that was used in this study. It will expound the research design, philosophical basis, target population, the sampling techniques, sample size and sampling procedure. The chapter will elucidate the data collection tools and procedure. Data analysis techniques that were used on both qualitative and quantitative data will be outlined.

### **4.2 Research Design**

A research may be qualitative or quantitative depending on the nature of the data to be collected and the methods used to collect data. This study used mixed methods. A mixed methods study combines quantitative and qualitative data collection and analysis in one study (Creswell, 2004). Individually, these approaches can answer different questions, so combining them provided the researcher with more in-depth findings. In addition, it provided stronger evidence and more confidence in the findings. Furthermore, the study employed convergent parallel design. Using this design, the researcher collected quantitative and qualitative data at the same time and analyzed the data separately. This is the most common and well-known approach to mixed methods (Creswell, 2004, Plano Clark, et al., 2003). The purpose of this design was to obtain different but complementary data on the same topic (Morse, 1991) to best understand the research problem. The intent in using this design was to bring together the differing strengths and non-overlapping weaknesses of quantitative methods (large sample size, trends, generalization) with those of qualitative methods (small N, details, in depth) (Patton, 1990).

### **4.3 Philosophical Underpinnings of the Study**

This research used pragmatism approach. The term "pragmatism" originates from the Greek noun "pragma" which means "works or deeds". In terms of ontology and epistemology, pragmatism is not committed to any single system of philosophy and reality (Bruce, 2018). Creswell (2014) regarded pragmatism as the philosophical foundation for mixed methods research. Pragmatism philosophy accepts concepts to be relevant only if they support action (Creswell, 2004). It states that knowledge of the multiple realities is therefore gained through an integration of multiple research methods encompassing both qualitative and quantitative research methods. Pragmatism

recognizes that there are many different ways of interpreting the world and undertaking research, that no single point of view can ever give the entire picture and that there may be multiple realities. Through the integration of qualitative and quantitative methods in this study, the researcher collected quality data and gained a better understanding of the problem under study from the views of people in Siachitema chiefdom as they narrated their climate change experience. This is a philosophy that considers the rationality of ideas by their results when put into practice/ real life. It inspires to look for the way outs and actions that guide us to reach our desired goal (Ornstein and Levin, 1999). This philosophical position requires the researcher to focus on the research problem rather than concentrating on methods or procedures and utilize all approaches in hand to probe into the issue (Rossman & Wilson, 1985). Pragmatism does not limit itself to any specific epistemology or ontology (Morgan, 2007). Following this philosophical viewpoint, researchers pursuing mixed methods employ both qualitative and quantitative standpoints to accomplish their target or goal. Philosophy of pragmatism offers researchers a flexibility in terms of choosing methods, techniques, and procedures of research that best suit their necessities and objectives. With pragmatism, the weaknesses of one method can be overcome by strength of the other method.

#### **4.4 Target Population**

The study targeted smallholder farmers in Siachitema chiefdom. Household heads were selected as the eligible participants in the study. Data from the chief retainers at the palace indicated that there were 13200 households in Siachitema chiefdom. Majority of households in this chiefdom were smallholder farmers who depended on rain-fed agriculture for survival, and were more likely to suffer from climate change shocks (UNDP, 2018). The study also targeted officials from ministry of agriculture, Zambia Farmers' Union, Conservation Agriculture Unit, Traditional Leaders, and Disaster Management Unit such as village heads.

#### **4.5 Sampling Techniques**

The study used homogeneous purposive sampling and simple random sampling. The former is a form of non-probability sampling in which researchers rely on their own judgment when choosing members of the population to participate in their surveys (Bernard, 2002) and it was used to pick key informants. Purposive sampling was used because the information amassed through this technique had a low margin of error, it helped saving time and money, and it gave an opportunity

to create generalizations from the data and gave the researcher opportunity to collect information from reliable and key informants (Cresswell and Clarke, 2011). The latter is a sampling technique where each unit of the population has an equal probability of inclusion in the sample (Bryman, 2012) and it was used to select respondents. Every smallholder farmer in Siachitema had an even chance and likelihood of being selected in the sample. The selection of respondents entirely depended on luck or probability. It is a fair method of sampling and it helps to reduce any bias involved compared to any other sampling method involved. Since the population size is vast in this type of sampling method, there is no restriction on the sample size that the researcher needs to create. From a larger population, a researcher can get a small sample quite quickly. Additionally, the data collected through this sampling method is well informed; more sample means better quality of data.

#### **4.6 Sample Size and Sampling Procedure**

A sample of 200 respondents (household heads) in Siachitema Chiefdom was used in this study as it was large enough to be considered representative. The decision to use this sample size was based on the G\*power calculation. Using the F tests family and a statistical test of ANOVA: fixed effects, omnibus, one-way, the G\*power analysis indicated that the minimum sample size to yield a statistical power of 95% with an alpha of 0.05 and effect size 0.25 was 200. Further, 10 key informants were sampled using homogeneous purposive sampling. These were from Zambia farmers' union, Traditional Leaders, Ministry of Agriculture, Conservation Agriculture Unit and Disaster Management. According to Smith (2004), a sample size is positively related to power. A small sample (less than 30 units) may only have low power while a large sample has high statistical power. Increasing the sample size enhances power. When the study has a large enough sample, every observation that is added to the sample only marginally increases power. The study randomly sampled 200 smallholder farmers using a village register which was supplied by traditional leaders; either the chief or senior village heads. Using the village register, a random sequential number was assigned to each smallholder farmer in Siachitema Chiefdom, in this case each household head was assigned a number which acted as an ID number. The numbers assigned to each household head were then written on different pieces of papers. Each number on its own piece of paper and the pieces of papers were put in a carton box. The researcher randomly picked 200 numbers from the box, with each number corresponding to the name of the household head in order to create a

sample. Before picking a number, the researcher ensured that the numbers were well mixed by thoroughly shaking the box so that everyone had an equal chance of inclusion in the sample. The 200 that were picked made the study sample.

## **4.7 Data Collection Tools and Procedure**

### **4.7.1 Semi-Structured Interview**

A semi-structured interview with closed-ended and open-ended questions was used to collect primary data from respondents. Closed-ended questions were designed for the purpose of getting the intended data in a more systematic way and the open-ended questions allowed respondents to express their experiences and feelings on their livelihood practices. Semi-structured interviews were administered to household heads who were randomly sampled using village registers. Further, a Likert scale was used to collect data on ranking the severity of climate change effects on livelihoods. This method of data collection was selected because it encourages two-way communication (Creswell, 2009). Further, Creswell (2009) states that both the interviewer and the respondent can ask questions, which allows for a comprehensive discussion of the topic under study. It also allows for open-ended responses from participants for more in-depth information. Using this tool allowed the respondents to express themselves as widely as possible.

### **4.7.2 Key Informant Interviews**

Interviews were administered to key informants. These officials were from Zambia farmers' union, Ministry of Agriculture, Conservation Agriculture Unit, Disaster Management and traditional leaders. The researcher interviewed two informants from each of the aforementioned departments. Informants were selected based on their expertise and experience on smallholder agriculture, livelihood diversification as well as interactions with local farmers.

### **4.7.3 Observation**

According to Reinharz (2011), observation method of data collection involves seeing people in a certain setting or place at a specific time and day. An observation checklist was used to collect observational data. The variables used were on-farm strategies, non-farm strategies, and off-farm

strategies. The researcher used these variables because they are the most cited livelihood diversification strategies in rural areas (Below et al, 2010). Residents of Siachitema were engaged in the aforementioned strategies, hence the reason to use these variables. The researcher was observing the on-farm, non-farm, and off-farm strategies employed by residents of Siachitema and observation was done anywhere in the chiefdom.

#### **4.7.4 Desk Research**

The researcher also employed secondary data in this study. The secondary data came from text books, journals, newspapers and reports. This complemented the primary data which the researcher gathered through semi-structured interviews. The researcher reviewed documents such as Journal of Agriculture Policy, a paper authored by Dr Kabwe Mubanga scholarly, Cogent Food and Agriculture Journal, a paper authored by Kassegn and Endris, Impacts of Climate Change Vulnerability on Livelihoods and the Environment, a document authored by Mseteka, Threats to food sufficiency among smallholder farmers in Choma, Zambia authored by Dr Kabwe Mubanga, The impact of livelihood diversification on household food security document authored by Ncube, Zimbabwe.

#### **4.8 Data Analysis**

Thematic data analysis was used to analyze qualitative data. The researcher closely examined the data to identify common themes such as topics, ideas and patterns of meaning that come up repeatedly (Creswell, 1994). There are various approaches to conducting thematic analysis. However, for this study the researcher followed the most common six step process: familiarization, coding, generating themes, reviewing themes, defining and naming themes and writing up. This method was selected because it is a flexible approach to qualitative analysis that enables researchers to generate new insights and concepts derived from data. The interpretation of themes is supported by data. The researcher used the NVIVO software to manage data. Data was imported into NVIVO software then the data was opened and explored. Nodes of key words from the data were made and search query was run for key word. A visual display was performed and insights were recorded. Analysis of variance (ANOVA), Least Square Difference (LSD), and spearman rank correlation were used to analyze quantitative data. These were employed to test the significance of relationships or differences between variables. Data from observation was analyzed

by comparing it with responses from smallholder farmers and key informants. Secondary data was analyzed quantitatively or qualitatively depending on its nature.

#### **4.9 Validity and Reliability**

The researcher ensured validity and reliability by checking the consistency of results across time, across different observers and across part of the study itself. Additionally, the researcher was also checking how well the results correspond to established theories and other measures of the same concept. In ensuring validity, the researcher used appropriate methods of sampling. To produce valid generalizable results, the population that was researched was clearly defined. It was made up of people from a specific geographical location and profession. In addition, the study had enough participants which was a microcosm of the population in Siachitema Chiefdom. To ensure reliability, the methods of data collection were applied consistently. Questions were phrased the same way throughout the study.

#### **4.10. Ethical Obligation**

The following ethical considerations were done before commencing the study.

##### **4.10.1 Seeking Permission**

Ethical clearance to conduct the study was obtained from the University of Zambia. Before going into the field, the researcher obtained permission from the gate keepers to conduct a research in their area, these included the Chief, village heads and ward councilors. This helped the researcher to carry out the study without resistance from the community.

##### **4.10.2 Privacy and Confidentiality**

The researcher safeguarded the privacy and identity of all the respondents. It was made clear right from the start that information obtained from the study would be treated with strict confidentiality, and will be used only for the intended research purpose. Participants' personal characteristics was not disclosed to anyone. Additionally, respondents were told before they assented to participate in the study that the researcher would like to publish the findings of the study.

#### **4.10.3 Informed Consent**

The researcher gave respondents sufficient information on the study in order for them to make informed decisions about their participation. It was made clear that any participant would be free to withdraw from the study at any time. No respondent was forced to give information during the study.

#### **4.10.4 Covid Guidelines**

The researcher bought masks which were used during data collection. Social distance during interviews was strictly followed

#### **4.11 Limitations of the study**

1. A large-scale study would have been better, but due to limited financial resources and time, the researcher undertook a small-scale study of only 200 households out of the total 13200 in Siachitema chiefdom. However, substantial information was still collected because respondents provided a lot of answers for each of the main questions.
2. The researcher could not access the latest population of Siachitema chiefdom in terms of number of women and men. The retainers at the palace only had the total number of households for the chiefdom.
3. The research had challenges with transport in the study area to access respondents. However, through the help of the chief retainers, all the respondents living in different parts of the chiefdom were accessed and successfully interviewed.

## CHAPTER FIVE: RESULTS AND DISCUSSION

### 5.1 Introduction

This chapter presents results and discussion on livelihood diversification strategies to combat impacts of climate change in Siachitema chiefdom. It shows the ranking of severity of climate change impacts, the livelihood strategies that people of Siachitema adopted to withstand climate change impacts and the contribution of adopted livelihoods strategies to household food security.

### 5.2 Demographic Characteristics of Respondents in Siachitema Chiefdom

The sample indicated a gender bias in respondents as the research was comprised of 66.5% men and 33.5% women (Figure 3). The bias in the gender of respondents was due to the fact that most households in Siachitema chiefdom were headed by males. However, during interviews with male headed households, the researcher allowed women to participate in the session because they were more vulnerable to climate change impacts than men, mainly because they represented the majority of the world's poor and were proportionally more dependent on threatened natural resources.

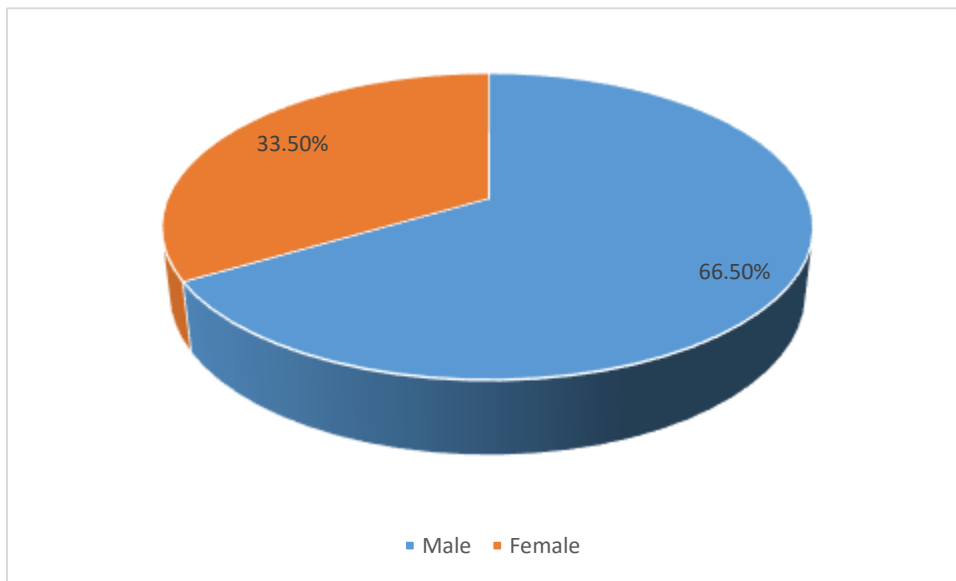


Figure 4. Gender of Sampled Respondents in Siachitema Chiefdom, 2022

Source: Field Work Data: 2022

Majority of the respondents were monogamously married (44%) and polygamously married (24%). The rest were divorced (12%), widowed (16%), or separated (4%).

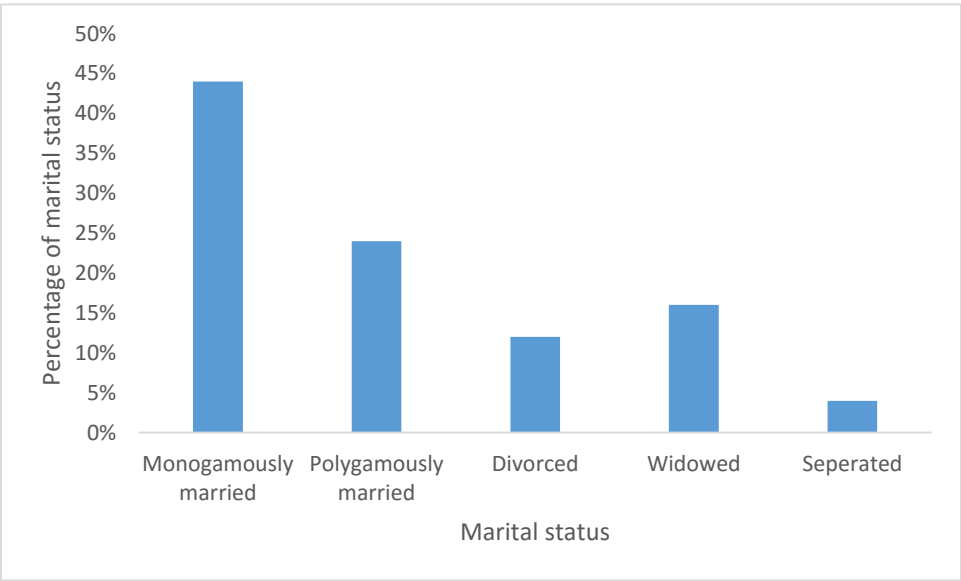


Figure 5. Marital Status of Respondents in Siachitema Chiefdom, 2022

Source: Field Work Data: 2022

More than half of the respondents reached secondary level of education (51%), while 45% reached primary level of education. Only 3% attained tertiary level of education while 1% never attended (Figure 5).

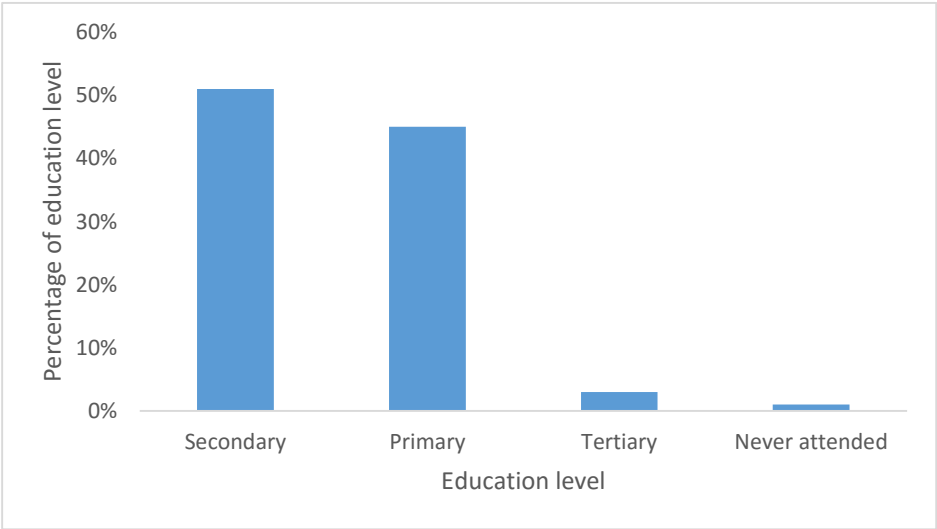


Figure 6. Education Level of Respondents in Siachitema Chiefdom, 2022

Source: Field Work Data: 2022

### 5.3 To Rate the Severity of Climate Change Effects on Identified Common Livelihoods in Siachitema

Before ranking the severity of climate change effects on common livelihoods (crop farming, livestock, gardening), farmers were asked to state the effects of climate change on the aforementioned livelihoods. The effects of climate change are summarized in the table below (Table 1).

Table 1. Summary of Climate Change Effects on Identified Common Livelihoods in Siachitema Chiefdom (Emerging themes from respondents)

| CROP FARMING                                                                                                                                                                   | LIVESTOCK FARMING                                                                                                                                                                                                 | GARDENING                                                                                                                                                                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Stunted growth. Dry soil and the loss of water through a high transpiration rate made crops experience stunted growth                                                          | Shortage of fresh water. Climate change reduced availability of fresh drinking water for livestock. Cattle as well as other domesticated animals suffered a lot especially in the dry season due to lack of water | Shortage of water for gardening in the off-season due to recurrent droughts in the chiefdom. This made it very difficult for smallholder farmers to flourish in gardening |
| Reduced soil moisture. Due to drought. Caused damage to crops particularly when it occurred during key stages of crop development                                              | Shortage of pasture. Climate change reduced forage for livestock. This weakened animals and, in some cases, it caused death                                                                                       | Increased temperatures in an already water stressed chiefdom severely affected gardening                                                                                  |
| Increase in pests and pathogens due to increased temperature. This posed an increased risk for crops to become infected with pests and pathogens, leaving the yields inedible. | Mastitis. A disease which caused inflammation of the udder and it was caused by bacteria due to intermittent heavy down pours experienced in the chiefdom                                                         |                                                                                                                                                                           |
| Destruction of crops due to occasional floods.                                                                                                                                 | Foot rot. Foot rot was a more aggressive progression of foot scald, an inflammation between the toes that affected one or more foot due to floods in the kraal and grazing areas                                  |                                                                                                                                                                           |
| Crop failure due to water stress                                                                                                                                               | Heat stress affected the immune system of animals.                                                                                                                                                                |                                                                                                                                                                           |
| Decreased crop yields due to increased temperature and reduced rainfall                                                                                                        | Increased death of livestock due to shortage of forage and water                                                                                                                                                  |                                                                                                                                                                           |

Increased temperature-destroyed crops and occasioned pests and pathogens

Source: Field Work Data: 2022

### 5.3.1. Severity of Climate Change Effects on Crop Farming

Respondents were asked to rate the severity of climate change effects on crop farming (Figure 6). Majority (80%) of the respondents said the impacts were very severe, 19% said impacts were severe, and 1% said they were moderate.

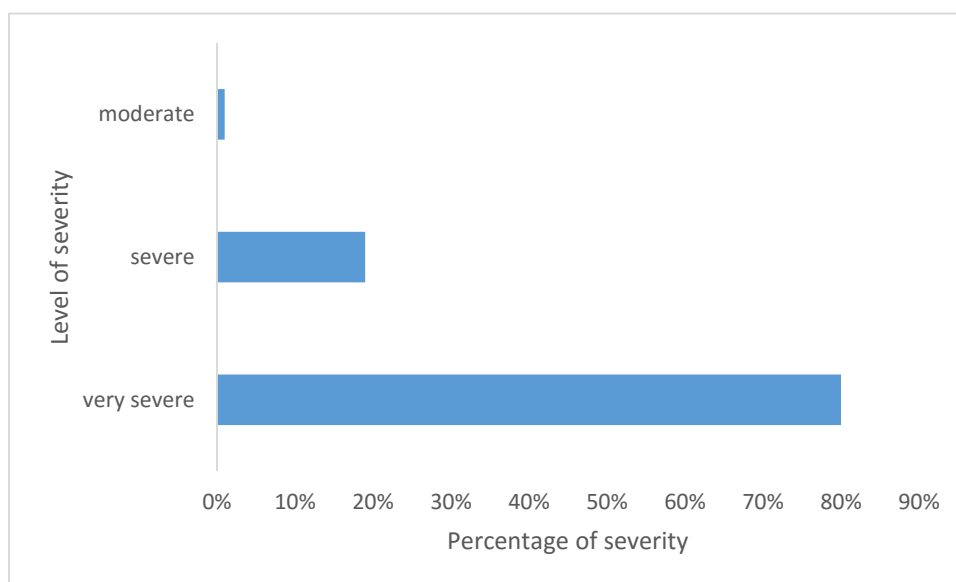


Figure 7. Severity of climate change effects on crop farming in Siachitema, 2022

Source: Field Work Data: 2022

Generally, most farmers said the impacts of climate change on crops were very severe. The presence of droughts and intermittent floods destroyed their crops and reduced yields. The shocks made it very difficult for them to eradicate poverty and be food secure. Agriculture in Siachitema is rain-fed, so any reduction in amount of rainfall has adverse effects on crops.

*“The effects of climate change on crops are very severe. There has been prolonged droughts and sometimes floods. This cause crop failure which makes it very difficult for me to eradicate poverty.*

*Sometimes these events occur one after the other and the consequences are catastrophic.”*  
(Respondent 4)

*“Droughts damage crops especially maize which is a staple crop and this reduces yields. My crops are not irrigated so I rely on rains. Droughts have not been friendly to crops because they destroy crops and leave my family stranded.”* (Respondent 9)

Respondents said they experienced droughts, floods and high temperature in the last farming season and they had no capacity to recover from the aforementioned shocks.

*“There were droughts and floods in the last farming season. The temperature was also very high in both events. It was very difficult for me to recover because these events occurred one after the other. There was stunt crop growth which reduced the quality and size of produce, resulting in low yields.”* (Respondent 18)

Some crops such as cowpeas which smallholder farmers adopted due to its early maturity were destroyed due to floods.

*“The floods I saw this year were completely new. I have never experienced such floods in this chiefdom. This chiefdom has been experiencing drought. Floods are rare here. My crops were destroyed and some washed away. Cowpeas which I planted because it matures early and can be harvested twice in the same farming season was destroyed, leaving me stranded. This crop (cowpeas) sustains my household during the farming season as I wait for maize to be ready. It is drought tolerant and just when I thought I had a solution to droughts, the chiefdom was hit with unprecedented floods.”* (Respondent 23)

A spearman rank correlation coefficient test was run to determine an association between gender and severity of climate change effects on crop farming (Table 2). The results indicated that there was a significant correlation between gender and the severity of impacts of climate change felt in Siachitema chiefdom ( $r_s = 0.140$ ;  $p = 0.049$ ). This implied that there was differentiated experience of climate change effects by the different genders. Generally, female respondents who were more severely affected by the effects of climate change, ranked the severity of climate change effects on crop farming higher than their male respondents. Data collected through observation supported

this finding. Women and girls in Siachitema carried the larger responsibility of household water supply, energy for cooking and heating, travelling longer distances to fetch for the aforementioned household needs. They were responsible for more time-consuming and labor-intensive tasks which were carried out manually or with the use of simple tools. While men had time for leisure and moving about in the community, women and girls barely had free time as they were always moving up and down to make sure that there was water, firewood in the household as well as doing other tasks. As such when climate change impacts their livelihoods, they are the most affected and severely feel the impacts more than their male counterparts.

Table 2. Spearman Correlation Coefficient test for the association between Gender and Severity of Climate Change effects in Siachitema Chiefdom, 2022

|                |                                                    | Gender of Respondent    | Severity of Climate Change Impacts on Crop Farming |
|----------------|----------------------------------------------------|-------------------------|----------------------------------------------------|
| Spearman's rho | Gender of Respondent                               | Correlation Coefficient | 1.000                                              |
|                |                                                    | Sig. (2-tailed)         | .140*                                              |
|                |                                                    | N                       | 200                                                |
|                | Severity of Climate Change Impacts on Crop Farming | Correlation Coefficient | .140*                                              |
|                |                                                    | Sig. (2-tailed)         | 1.000                                              |
|                |                                                    | N                       | 200                                                |

\*. Correlation is significant at the 0.05 level (2-tailed).

Source: Field Data: 2022

Spearman correlation coefficient test (Table 3) was run to determine whether there was an association between the level of education and the respondents' ranking of climate change effects on crop farming on the severity scale. The results showed that there was no correlation between level of education and the respondents' ranking of climate change effects in Siachitema on a severity scale ( $r_s = 0.047$ ;  $p = 0.507$ ). Education levels did not affect the respondents' experience of climate change effects and hence their ranking of climate change effects on a severity scale.

This implied that respondents of different education backgrounds felt the effects of climate change in the same way.

Table 3. Spearman Correlation Coefficient Test to Determine Correlation between Level of Education and Severity Ranking of Climate Change effects on Crops in Siachitema Chiefdom, 2022

|                |           |                         | EDUCATION | RANKING |
|----------------|-----------|-------------------------|-----------|---------|
| Spearman's rho | education | Correlation Coefficient | 1.000     | -.047   |
|                |           | Sig. (2-Tailed)         | .         | .507    |
|                |           | N                       | 200       | 200     |
|                | ranking   | Correlation Coefficient | -.047     | 1.000   |
|                |           | SIG. (2-TAILED)         | .507      | .       |
|                |           | N                       | 200       | 200     |

Source: Field Data: 2022

Climate change caused severe crop failure in the chiefdom because of recurrent drought. There was decreased soil moisture which was cardinal in the growth of crops. Even short-term drought in the chiefdom caused significant damage to crops particularly when it occurred during key stages of crop development such as germination and/or pollination stage and this resulted in low yields. These findings correspond with Bals et al (2008) who disclosed that climate change effects such as drought reduce soil moisture content which is important for crop yields. Further, Bals (2008) states that low soil moisture result in crop yield reduction. Crops in Siachitema are not irrigated and therefore rely heavily on rainfall for moisture. As soil moisture decrease, crops desiccate and become more vulnerable to pests. Climate change posed an increased risk for crops to become infected with pests and pathogens, leaving the yields inedible. As temperature increased, pest outbreak became common. The pathogens were a danger to crop production and food security. The increase in temperature also had adverse effects as crops became dry. Farmers emphasized the catastrophic impacts climate change had on their livelihoods and the chiefdom at large, leaving them with reduced food and income. They had to come up with alternative income sources in order

to sustain themselves. These findings confirm Gautam et al (2013) revelation that increase in temperature causes infestation of pests and diseases on crops and this reduces yields, thus posing a threat to food security.

Female-headed households were particularly vulnerable to climate change. Due to decline in household income, women and girls' vulnerabilities increased. Children increasingly entered the workforce and young girls were married off when parents could not afford school fees. Drought caused stunted growth in crops, this resulted in a decline in the size and quality of produce. Dry soil and the loss of water through a high transpiration rate make crops experience stunted growth. As a result, the development of some structures is compromised and growth rate slows. Farmers complained about the impacts of increased temperature and water stress on crop yields. In the previous farming season, Siachitema chiefdom experienced both droughts and floods with very high temperatures. A situation that was disastrous and had long lasting consequences in terms of food security.

Occasional floods destroyed crops and washed away soil nutrients and fertilizer. The floods that Siachitema community experienced in the last farming season were unprecedented. Farmers particularly in Kalonda ward of Siachitema chiefdom had their crops (maize, groundnuts, sunflower, cowpeas) submerged. In some areas crops were washed away due to heavy downpour, destroying even crops which were ready to be harvested such as cowpeas. Climate change presents a substantial challenge to agricultural development in the chiefdom. From food security, nutrition to sustainable management, it is a significant threat to the welfare of people. The findings are supported by Connor et al (2022) who revealed that in Southern Africa, floods destroy crops and degrades food security. Further, Connor et al (2022) states that in Mozambique, flooding destroyed 3 to 4% of all crops and killed thousands of livestock. Without extensive current strategies on adaptation for agriculture in Siachitema, the chiefdom will remain vulnerable in its exposure to the widespread effects of climate change. The effects on crop farming were so severe such that some households did not harvest anything from their fields. The combined effect of heat and drought stress had a damaging outcome on crops. The key stages of crop development were badly affected due to water stress. Similarly, an increase in temperature also had a catastrophic outcome on crops.

### 5.3.2 Severity of Climate Change Effects on Livestock Farming

Majority of respondents (Figure 7) said the effects were very severe (58%), 39% severe, and 2.5% moderate.

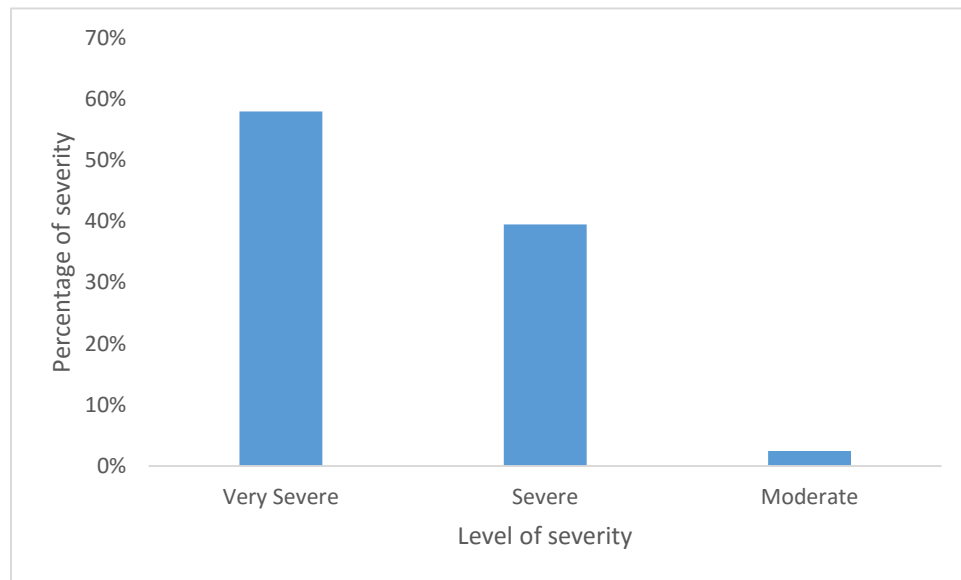


Figure 8. Severity of Climate Change Effects on Livestock Farming in Siachitema, 2022

Source: Field Data: 2022

There was a general consensus among farmers that climate change had very severe effects on livestock. They narrated their experience about how climate change affected livestock in the chieftdom. The shortage of forage and drinking water was a source of conflict in the community because some farmers did not want other people's animals to graze in their territory. Climate change had an adverse effect on livestock farming. Farmers complained about not having adequate pasture and fresh drinking water for their animals.

*“Prolonged droughts result in shortage of pasture and fresh drinking water for domesticated animals. These impacts are very severe especially on cattle. Lack of drinking water and pasture result in death of animals and those that survive severely lose weight. Floods in this chieftdom are rare. Floods have both positive and negative side. When there are floods it means there will be plenty of pasture and drinking water for animals. On the negative side, floods cause hoof, foot, mastitis (daily animals) diseases in goats and cattle.”* (Respondent 31)

Smallholder farmers bemoaned the lack of a big river that can hold water for a longer period or water harvesting methods in the chiefdom.

*“I face a lot of challenges in the dry season due to scarcity of drinking water for my animals. There is no big river in this chiefdom and I have no knowledge of water harvesting. So I rely on small streams and shallow wells but the problem is that these streams and wells dry up before the next rain season. This area no longer receives adequate rainfall and the little water stored in streams finishes sometimes even before the second half of the year.”* (Respondent 40)

The effects of climate change were so devastating on livestock and this resulted in death of some animals.

*“My animals lose weight and eventually die due to lack of forage and water. Cows are the most affected because they depend largely on grass. When grass doesn’t grow because of drought, it means there will be no food for cattle. This has been the case for many years in Siachitema chiefdom. When I take these animals to abattoir for sale, I do not get as much money as I should because of reduced weight.”* (Respondent 43)

There was a consensus among smallholder farmers in Siachitema chiefdom that climate change caused mastitis in dairy animals, a disease that caused sores on the udder due to floods.

*“I noticed something very strange in the last rain season. My dairy animals started developing sores and swollen udder due to floods. I stopped milking the affected cows until the sores completely healed.”* (Respondent 70)

The results in table 4 showed that there was no association between gender and severity of climate change effects on livestock ( $r_s = 0.009$ ;  $p = 0.9$ ). Gender had no influence in ranking the severity of climate change effects on livestock farming in Siachitema chiefdom. However, male respondents were more knowledgeable about impacts of climate change on livestock farming. This was due to the fact that they were in charge of heading cattle and other domesticated animals. So, they understood the impacts very well better than females. However, women have also learned how climate change impacts livestock through interaction with the males and also observation. As

such, the spearman test recorded a no significant difference in the ranking of the impacts on livestock between the genders.

Table 4. Spearman Correlation Coefficient Test for the Association between Gender and Ranking Severity of Climate Change effects on Livestock Farming in Siachitema Chiefdom, 2022

|                |                                                 | Gender                  | Severity of Climate Change Impacts on Livestock |
|----------------|-------------------------------------------------|-------------------------|-------------------------------------------------|
| Spearman's rho | Gender                                          | Correlation Coefficient | 1.000                                           |
|                |                                                 | sig. (2-Tailed)         | .009                                            |
|                |                                                 | N                       | 200                                             |
|                | Severity of Climate Change Impacts on livestock | Correlation Coefficient | .009                                            |
|                |                                                 | sig. (2-Tailed)         | 1.000                                           |
|                |                                                 | N                       | 200                                             |

Source: Field Data: 2022

As shown in Table 5, the level of education and ranking severity of climate change effects on livestock farming did not have a correlation ( $r_s = -0.024$   $P\text{-value} = 0.737$ ). Majority of respondents attained primary and secondary education but their levels of education did not affect the ranking of climate change effects. The ranking was based on their lived experience of climate change. Most of the respondents were residents of Siachitema Chiefdom since birth and their ranking was based on experience rather than education.

Table 5. Spearman Correlation Coefficient Test to Determine the Relationship between Level of Education and Ranking Severity of Climate Change effects on Livestock Faming in Siachitema Chiefdom, 2022

|                |                                                 |                         | Level of education | severity of climate change impacts on livestock |
|----------------|-------------------------------------------------|-------------------------|--------------------|-------------------------------------------------|
| Spearman's rho | Level of Education                              | Correlation coefficient | 1.000              | -.024                                           |
|                |                                                 | sig. (2-Tailed)         | .                  | .737                                            |
|                |                                                 | N                       | 200                | 200                                             |
|                | Severity of Climate Change Impacts on Livestock |                         | -.024              | 1.000                                           |
|                |                                                 | Correlation Coefficient |                    |                                                 |
|                |                                                 | sig. (2-Tailed)         | .737               | .                                               |
|                |                                                 | N                       | 200                | 200                                             |

Source: Field Data: 2022

Climate change usually gets its reputation from its impact on crops. However, its impact on livestock can equally be dramatic. Climate change reduced availability of fresh drinking water for livestock. Cattle as well as other domesticated animals suffered a lot specifically in the dry season due to lack of water. Shallow wells and streams dry up in the second half of the year before the next rain season, leaving smallholders farmers stranded. Some farmers were compelled to temporarily migrate to Kafue flats in order to access water for their animals. Others resorted to pumping water from boreholes for animals to drink. Naqvi et al (2015) states that climate change reduces water resource availability for livestock. Livestock face the problem of water scarcity in most of the time of the year due to climate change. Naqvi (2015) argues that the higher the temperatures, the higher the demand of water for animals. The consumption of water increases 2 to 3 times in a day. Livestock make a major, although largely underestimated, contribution to development in the chiefdom of Siachitema. They produce, enhance crop production and provide additional economic goods and services as well as cash income. The sale of livestock products provide income for purchasing crop inputs and food. However, these benefits are diminishing

gradually in Siachitema due to severe impacts of climate change. The population of livestock, especially cattle has declined over the years and this is a serious impediment to development in Siachitema.

Climate change reduced forage for livestock, a situation that adversely affects animals. Due to recurrent and intra-seasonal drought in Siachitema, grass and plants struggle to grow. No water means no growth of grass and plants. This results into overgrazing in areas where there is little pasture. Due to low availability of forage in Siachitema, cattle resorted to eating poisonous plants which caused abortions in some female cows and increased nitrate accumulation. The findings agree with Singh (2022) who argues that prolonged drought suppresses livestock sustainability due to competition for forage and water. Hence, destocking could be adopted so as to ease pressure on both animals and environment. Some cattle developed lumpy jaw and woody tongue from eating sharp and dry forage. There was also increased incidence of soil-derived diseases (anthrax, blackleg) because of grazing closer to the ground. In addition, production of milk decreased due to low availability of forage. In the chiefdom of Siachitema, milk is always treasured as people use it for consumption as well as generating income by selling. However, its production has dwindled due to changes in climate. Data from key informants revealed that heat stress has significant direct impact on livestock farming. It caused a decrease in milk component and production, meat production, reproductive efficiency and the health of animals. In addition, heat stress gave rise to metabolic disorders, oxidative stress, and immune suppression. These impacts led to the death of some animals, leaving farmers devastated. The findings correspond with Singh (2022) who in his study disclosed that cattle succumb to heat stress as a result of stealth change in temperature, which reduces production more especially among dairy cattle. Furthermore, routine movement of cattle to abattoirs can be affected as a result of extreme high temperatures, which may significantly distort meat quality. Climate change triggered mastitis in dairy animals, a disease that causes inflammation of the udder and it is precipitated by bacteria because of flooding. Farmers observed inflammation of the udder in dairy animals during floods. This occurred when the kraal and/or grazing areas were awash due to continuous heavy downpour. This unfortunate condition made it difficult for farmers to milk their animals. They were compelled to wait until the sores healed completely.

There was serious foot rot in livestock during floods, especially in small ruminants. Foot rot is a more aggressive progression of foot scald, an inflammation between the toes that affects one foot. It also occurs in one or more feet as observed during the study, causing severe lameness. The lameness in some goats was observed during interaction with farmers. Some lost their hooves and they were permanently lame. The veterinary department did not have adequate manpower to treat animals in the chiefdom, a situation that is begging serious and urgent attention from Government and other actors of rural development. Despite the negative side of climate change discussed above, there was a positive side of this occurrence. Much as floods may be catastrophic to smallholder farmers in Siachitema, their presence meant availability of fresh drinking water for animals.

### 5.3.3 Severity of Climate Change Effects on Gardening

The impacts of climate change on gardening were not as severe as compared to crop and livestock farming (Figure 8). The majority of the respondents (48%) said the impacts on gardening were moderate, 40% said the impacts are severe, 6.5% said they were very severe while 5% not severe.

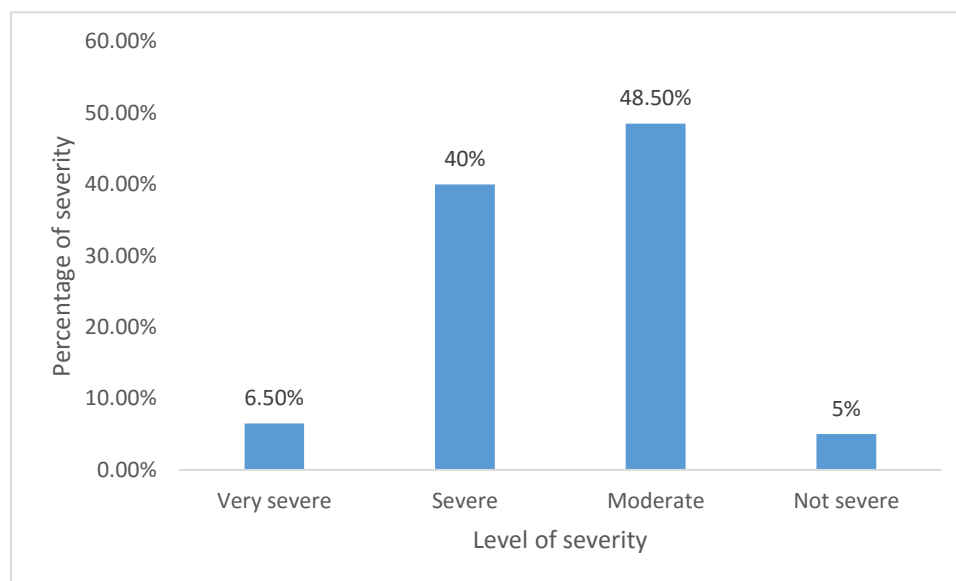


Figure 9. Severity of Climate Change Effects on Gardening in Siachitema Chiefdom, 2022

Source: Field Data: 2022

Gardening was another common livelihood in Siachitema Chiefdom besides crop farming and livestock. This form of livelihood was done in the off-season and it helped the inhabitants of this chiefdom to generate rapid income.

*“The impacts of climate change on gardening are moderate. I am saying moderate because when streams dry up, I dig wells and use the water for gardening. This strategy helps me to maintain my garden in the dry season at least for a certain period of time.”* (Respondent 13)

*“Gardening is the major activity in the off-season for me. Drought has made it hard for me to do this in the dry season due to lack of water. Streams dry up sometimes even before the second half of the year. I am forced to dig wells in these streams and use the little water I find for gardening and this reduces the effects of climate change on this livelihood. Sometimes I set up my garden near community boreholes but this move is always received with mixed feelings from traditional leaders because these boreholes are community properties which are meant only to provide water for domestic use.”* (Respondent 102)

Some respondents had different views on the effects of climate change on Gardening. Those who said the impacts were severe on gardening complained that when streams dried up, they struggled to maintain their gardens because they did not find water after digging wells. This was due to low water table in some areas in the chiefdom.

*“The impacts on gardening are severe. Because of prolonged droughts in the chiefdom, water levels in streams is low most times and streams dry up in the second half of the year when gardening reaches peak. I try to dig wells to support my garden but I do not find water. It looks like the water level underground is very low here. I am forced to harvest all my vegetables and sale in Kalomo town because maintaining a garden when water is scarce is impossible.”* (Respondent 107)

Apart from crop and livestock farming, gardening was another common livelihood practiced by people of Siachitema chiefdom and it was done in the lean season. This livelihood was readily accessible to most people. It is very common in the off-season and valuable to the households as it offers a way to generate a small income rapidly. In addition, farmers may save money which they could have used to buy vegetables. People made small investment in seeds and a small amount

of labor which provided a small return from the sale of vegetables within six to eight weeks. Climate change did not spare gardening because it was largely dependent on water in streams. Recurrent droughts in the chiefdom made it very difficult to flourish in gardening. Streams in the chiefdom have no capacity to hold water that can sustain gardening throughout the off-season. However, the impacts of climate change on gardening are not as harsh as compared to crops and livestock. When streams dry up, farmers dig shallow wells in the same streams or on flat land to support gardening, although at some point water completely stops coming out and at this point, they remove all the vegetables from the garden to avoid making losses. The increase in temperature was another obstacle to gardening in an already water stressed chiefdom. The catastrophic impact of increased temperatures on gardening is something farmers could not cope up with. The occurrence of climate change shocks one after the other threatened sustainability of Siachitema residents, an unfortunate situation that impeded development in the chiefdom.

#### **5.4 To Assess the Livelihood Diversification Strategies Adopted by Residents of Siachitema Chiefdom**

Residents of Siachitema chiefdom employed different livelihood diversification strategies in order to tackle the effects of climate change. The strategies are in three forms; on-farm, non-farm and off-farm. The on-farm livelihoods diversification strategies adopted by residents of Siachitema chiefdom include; Conservation farming (Magoye Ripper, Ground Basins), planting early maturing seeds, drought tolerant crops (Crop diversification), planting crops near hand pumps, investing in small livestock and cross-breeding to increase resistance to diseases, intercropping, application of cow dung. Respondents said they were introduced to conservation farming, a new system of farming that promised to help them combat climate change impacts, eradicate poverty and ensure sustainability.

*“I was introduced to conservation farming, a very good method of farming which has helped me to fight climate change. I get good yields from this type of farming and it can also be done in the off-season in gardens before streams dry up. It is a smart way of farming because it does not waste soil. With this method of farming, I am assured of having food all the time.”* (Respondent 40)

Ground basin (Potholing) farming was by far better than conventional farming. Some farmers who were still skeptical about the former carried out an experiment by planting same seeds of maize at the same time and same day, one conventional field and one potholing field (Figure 9 a and b).



Figure 10 (A) Ground Basin (Potholing) Maize and Okra Field in Siachitema, 2022. (B) Conventional Farming Maize Field in Siachitema Chiefdom, 2022. Source: Field Data: 2022

As shown in figure 9 a, and b, there was a huge difference between maize planted in ground basins and the one in conventional farming. The maize in figure 9 a, grew faster than the maize in figure 9 b. This experiment was conducted in May by a smallholder farmer who wanted to be very sure that this type of conservation farming was better than conventional farming.

*“I have been seeing my colleagues in the community doing this method of farming but I was not too sure if it was the right strategy to combat impacts of climate change. So, I decided to do an experiment on a small piece of land and my conclusion is that this is the best strategy because the crops are able to survive drought. I have only watered the basins twice, during planting and after germination. The basins keep and hold moisture to support the growth of crops such that even in times of droughts, crops cannot die.” (Respondents 55)*

Farmers switched to growing early maturing seeds such as Dkc 80-33, pan 413, SC 413, SC 303, and drought tolerant crops such as cowpeas, millet as a way of combating impacts of climate change.

*“The rainfall pattern in this chieftdom is erratic and short. This area has been experiencing prolonged droughts for some years and sometimes floods. I was introduced to early maturing and drought tolerant crop varieties. This strategy has been very helpful because my crops mature before the rain season ends and some varieties are tolerant to droughts. Some early maturing food crops can be harvested twice in a season like cowpeas.”* (Respondent 57)

The non-farm activities in Siachitema chieftdom were as follows; engaging in piece works in towns during off-season, brick molding, village banking, enrolling in social cash transfer, petty trading, charcoal burning, brick laying, Selling beer. These activities took place mostly in the off-season except social cash transfer, a government funded programme in which people over 65 years and individuals with severe activity limitation received money bi-monthly. Farmers got busy with non-farm activities during the off-season as it helped them to generate income which in turn was used to buy food and farming inputs.

*“Because of climate change, I have been forced to start selling beer to help me generate income which I invest on farms and I also use it to buy food. The yields I get from my fields are not enough to sustain my household so the little I get from these activities help me to fight hunger.”* (Respondent 111)

Brick molding was a common strategy in the chieftdom during the off-season due to high demand of bricks in nearby urban areas.

*“I mold bricks and sale to people in urban areas. The income I get from this business is used to buy food and farming inputs. Although this chieftdom experience prolonged drought, I can’t stop farming because it is my way of life. It is better to harvest something even if it is small than do nothing.”* (Respondent 133)

There was increase in charcoal burning activities in the chiefdom in order to generate income, a livelihood diversification strategy that most males took keen interest in. Respondents said they had no option but to turn to their immediate environment for survival.

*“I have been warned by the forest department several times to stop charcoal production but this is not possible because this diversification strategy gives me income during the off-season and I use the money to buy food. I do not have an option. Maize and other crop yields have been reducing so I rely on such businesses to generate income for food and other basic needs.”* (Respondent 97)

Some smallholder farmers ventured into village banking, a profit-making scheme where people came up with different groups and pumped in different amounts of money.

*“I decided to engage in village banking so that my income could increase. There are six people in my group and so far, so good. There is maximum trust among members of the group. Some people decline to be part of this business because they think their money will be stolen. Others do not just have capital to kick-start.”* (Respondent 279)

Off-farm activities involved doing piece works in other people’s farms. This livelihood strategy was not common in the chiefdom.

*“I do piece works in other people’s farms. After working, they give me money or sometimes bags of maize or mealie- meal.”* (Respondent 77)

All the respondents adopted early maturing crops 100% (Figure 10), conservation agriculture adoption was 45%, drought tolerant crops 60%, small ruminants’ adoption was 80%, adoption of intercropping was 73%, application of cow dung was at 27%, and migrating animals to areas with water and forage was 54%. Conservation agriculture is slowly gaining momentum in the chiefdom. Some farmers were still naïve about it but after seeing what their fellow farmers produced from conservation methods and the sensitization done by agriculture extension officer, they vowed to adopt it.

*“I did not know about conservation agriculture. I am happy to see what my fellow farmers have produced from this farming method. It is a method that can allow me to plant maize and other*

*crops even in the dry season by watering basins. I will also start using this method of farming.”*  
(Respondent 293)

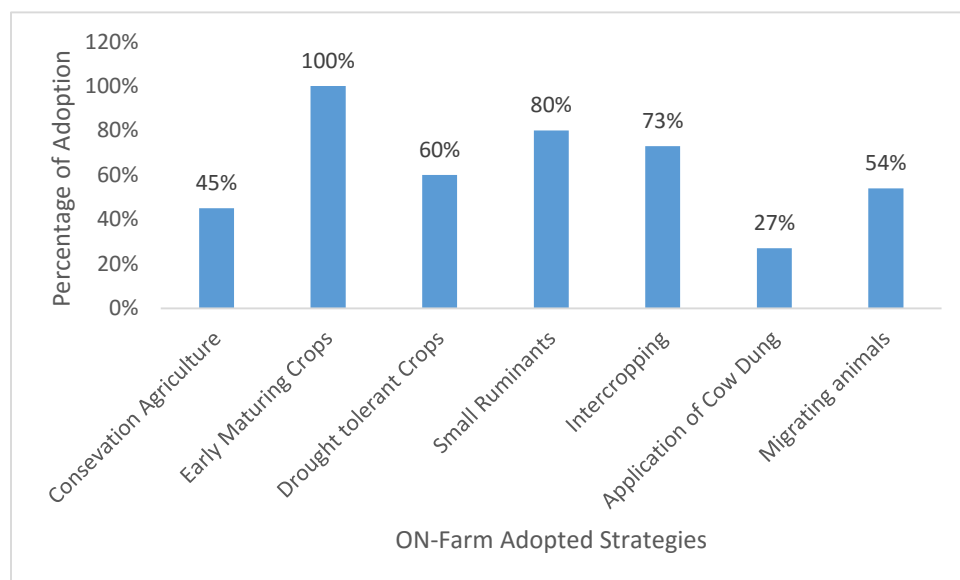


Figure 11. ON-Farm Adopted Strategies. Source: Field Data: 2022

Adoption of piece works in urban areas was at 47%, molding bricks 26%, village banking 18%, social cash transfer 32%, petty trading 41%, charcoal burning 39%, brick laying 21%, and remittances 53%

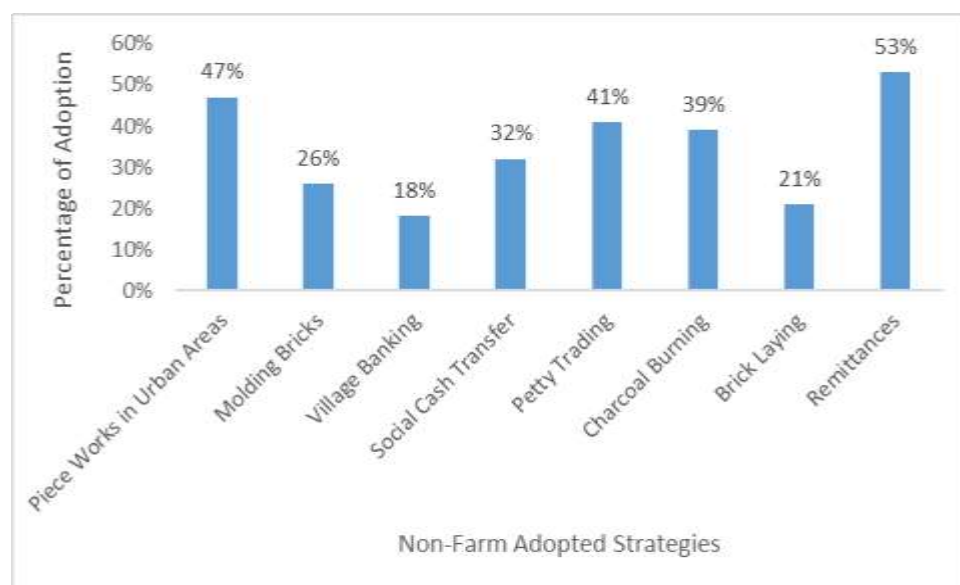


Figure 12. Non- Farm Adopted Strategies. Source: Field Data: 2022

The diversification strategies are summarized in the table below (Table 6). The strategies are divided into; On-farm, Non-farm and Off-farm. Generally, farmers combined different on-farm strategies to produce good yields. Non-farm strategies were very common in the lean season. However, a few farmers engaged in petty trading and traditional beer brewing during farming season, mostly in the afternoon. Social cash transfer was the only uninterrupted strategy. The beneficiaries received money every month, which they used to buy food and other necessities.

Table 6. Summary of Livelihood Diversification Strategies Adopted by Residents of Siachitema Chiefdom to Combat Effects of Climate Change (Emerging themes from respondents)

| ON-FARM                                                                                                                                                                                                                                                                         | NON-FARM                                                                                                                                                       | OFF-FARM                                                                                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| Conservation farming. (a) Magoye ripper. A type of conservation farming which allows minimum tillage of land (b) Ground basin. This is a form of conservation agriculture which has been adopted by smallholder farmers. It involves digging small and big holes in the ground. | Engaging in piece works in towns- During off-season and remittances from relatives living in urban areas.<br><br>Brick molding and selling them in urban areas | Doing piece works in other people's farm. They were given money or bags of maize or mealie-meal |
| Planting early maturing seeds. These mature early and helps farmers to fight climate shocks                                                                                                                                                                                     | Village banking. A microcredit methodology whereby financial services are administered locally rather than centralized in a formal bank                        |                                                                                                 |
| Planting drought tolerant crops- such as cowpeas, millet, and sorghum.                                                                                                                                                                                                          | Social cash transfer. A regular, non-contributory payments of money provided to incapacitated individuals and households by government                         |                                                                                                 |
| Keeping small ruminants. These were able to survive climate change shocks                                                                                                                                                                                                       | Petty trading. This involved selling of various items such as clothes, fritters, cooking oil and salt in small quantities                                      |                                                                                                 |
| Intercropping. Inter-cropping improved yields per acre and helped control pests and diseases that accompanied droughts.                                                                                                                                                         | Charcoal production which they sold to nearby and distant towns                                                                                                |                                                                                                 |
| Application of cow dung. Cattle manure had high water content and organic material. It improved water filtration and had holding capacity                                                                                                                                       | Brick laying in towns to generate income                                                                                                                       |                                                                                                 |

|  |                                                                                           |
|--|-------------------------------------------------------------------------------------------|
|  | Traditional beer brewing (locally known as gaankata and kachasu) to generate rapid income |
|--|-------------------------------------------------------------------------------------------|

Source: Field Data: 2022

#### 5.4.1. On-Farm

Smallholder farmers declined to bow down to the effects of climate change and adopted numerous sustainable strategies to diversify their livelihoods in order to ameliorate the shocks. The strategies help them to withstand climate change. Conservation agriculture was slowly being accepted by farmers as one of the most reliable ways of combating impacts of climate change in the chiefdom and 45% were found to be practicing conservation agriculture. Ground basin (Pothole farming) was adopted by smallholder farmers in Siachitema Chiefdom, although the adoption rate was slow. This mode of farming is done by digging small and big holes in the ground (Figure 10). Women were very much involved in digging small holes while men were involved in digging big holes and ripping. The findings of this study agree with Nyanga (2012) who disclosed that Zambia has been quite successful in increasing adoption of conservation agriculture (CA) among smallholder farmers and that women were involved in conservation agriculture (CA) basins while men were mostly involved in ripping and this supports the findings of this study. The big holes are about one meter deep. After digging, they buried organic manure into the holes and waited for rains before planting (Figure 12).



Figure 13. Pictures of potholes in Siachitema Chiefdom, 2022. Source: Field Data: 2022

This method of farming was also done in the dry season by pouring into the basins water either from boreholes or shallow wells. Each basin has a carrying capacity of thirty seeds of maize and they are only watered thrice, during planting, germination and pollination stage. Conservation agriculture is based on three key principles; minimal tillage or soil disturbance, permanent soil cover using mulch or other crops, crop rotation or inter-cropping which involves growing two or more crops together (FAO,2010). In line with these principles, smallholder farmers made basins which helped crops to survive drought by keeping them hydrated for a longer period than tilling and watering the entire field. The ground basins retained and kept moisture which was needed for growth of crops due to organic manure which they buried inside. Crops were able to survive prolonged drought because of retention of moisture in the basins. This is why it is easy for farmers to plant maize using this method even in the dry season because once the basins are watered once or twice, they retain and keep moisture.



Figure 14. Picture of a pothole with organic manure in Siachitema Chiefdom, 2022

Source: Field Data: 2022

According to Lin (2011), the planet's soils contain more carbon than its atmosphere and vegetation combined, and the tilling involved in many conventional farming methods releases that trapped carbon back into the atmosphere, resulting in climate-heating atmosphere. With ground basins (Potholing) approach to farming in Siachitema chiefdom, farmers only disturbed the soil exactly where crops were planted, releasing less carbon. This type of conservation farming was very effective and helped many smallholder farmers to combat impacts of climate change as it required less water. With this method, each planted seed of maize or any other crop can survive up to maturity level and be harvested. Farmers that adopted this strategy were able to harvest adequate grains of maize and okra. Most of them opted to sale the okra in Kalomo town and the rapid income generated from this was invested in their farms.

Smallholder farmers resorted to planting early maturing maize varieties and the adoption rate was 100% such as Dkc 80-33, pan 413, SC 413, SC 303, zms 520 and this strategy made a significant contribution to combating impacts of climate change. These varieties were adopted by smallholder farmers in Siachitema because they matured early. Farmers were able to harvest grains from their fields though the yields were not very good due to severe drought and in some cases floods.

However, the yields of early maturing maize varieties were by far better than yields of late maturing ones. The former yielded a good harvest within three months of planting and this protected farmers from low rainfall or drought. These findings agree with Mubanga and Mbewe (2020) who conducted a similar study and made a revelation that smallholder farmers opted to plant early maturing maize varieties as an adaptation to climatic conditions. Drought tolerant crops (such as cowpeas, cassava and millet) were also adopted, and 60% embraced this strategy, although the adoption rate for cassava and millet was very low. Among the three aforementioned drought tolerant crops, cowpeas were widely accepted by farmers. This crop is not only drought tolerant but also an early maturing crop. The crop was harvested twice in a season because of its early maturity. When planted at the beginning of the farming season (late November), farmers were able to harvest it by early or mid-January. Then immediately after harvesting, they planted and harvested again in March. This is supported by Mubanga and Umar (2014) who said that farmers in Chihepo adapted by practicing crop diversification because it helps increase their household food security. This is so because during periods of drought, the drought tolerant crops survive and are harvested. For many years, the inhabitants of Siachitema depended on growing maize, a crop which is highly vulnerable to drought and flooding. However, the occurrence of prolonged weather events which reduced yields made them realize the need to diversify their livelihoods. Majority of respondents expressed happiness with cowpeas as it helped them to eradicate poverty. These strategies combined helped to minimize the impact of climate change on farming activities in the chiefdom.

Farmers inter-cropped maize with okra and leguminous crops. Inter-cropping improved yields per acre and helped control pests and diseases that accompanied droughts. Intercropping crops with maize was a way of diversifying crops to include varieties that were drought tolerant. This is highly beneficial to farmers because even when the maize does not do well, the other crops inter-cropped with it may enable farmers to be food secure. Additionally, Soil fertility is improved when maize is inter-cropped with leguminous crops. Legume crops were used as food crop and cash crop. The income generated from the sale of legumes was used to purchase food in critical times and farming inputs for the next planting season. The fact that crops intercropped with maize can be used as cash crops as well as food crops provides a sustainable coping strategy for smallholder farmers.

Farmers were introduced to Magoye Ripper and men were mostly involved in this method (Figure 14), (locally known as Kapandula). Smallholder farmers in Siachitema only opened up planting furrows leaving the soil of the other part of the field undisturbed. Because of this method of farming, the soil was not at risk of wind and water erosion due to the cover provided by the layer of mulch of vegetation on undisturbed ground. Farmers revealed that ripping opened up the soil for easy root and water penetration. The deep furrows improved water infiltration and harvested water which was needed for crops to grow. Furrows trapped and conserved water and moisture which enabled crops to grow fast and survive severe drought. Gart (2004) supports these findings by arguing that maize grown in ripped rows has been observed to grow much faster with higher vigor than that grown under conventional practice due to concentrated inputs and soil moisture. In the face of climate change, ripping the land is an exceptionally good coping strategy for smallholder farmers. Unlike ploughing which turns the soil inside out and allows quick loss of moisture due to evapotranspiration, a natural process that deprives land the much needed moisture for growth of crops, ripping the land creates linear grooves in the soil in which the seeds are planted. The undisturbed part of the field preserved soil moisture underneath them and farmers expressed maximum satisfaction with this conservation method of farming. Water that penetrated through undisturbed soil (Soil between furrows) combined with the one in furrows meant more water and moisture for growth of crops. This method of farming was done before the onset of the rain and it had a better yield because crops could withstand drought. Successful ripping of the land required a chain of 3.5 metres, two pairs of oxen because the ripper was heavy, a ripper, a plough beam, a 180-centimeter yoke. The pair of oxen used during ripping were not used during the on-season as they were perceived to be exhausted. The rippers were distributed by Non-Governmental Organizations. Farmers were put into groups of five and each group was given one ripper which rotated among members. Despite magoye ripper being one of the solutions to combating climate change impacts, it was not readily available on the market.



Figure 15. Picture of Magoye Ripper. Source: Field Data: 2022

The use of cow dung as fertilizer had also gained momentum in the chiefdom due to climate change. Farmers believed that cattle manure had high water content and organic material. Additionally, it improved water filtration and had holding capacity, this meant reducing runoff and keeping moisture for many days to support growth of crops even in drought times. The availability and sustainability of suitable and good quality drinking water is a serious global concern. Such uncertainties threaten livestock production with an attendant ripple effect on food security. For this reason, most of the smallholder farmers in Siachitema embraced the need to keep more small ruminants such as goats and sheep in order to combat impacts of climate change. The aforementioned animals were able to survive with little water and harsh environment when compared with large ruminants. In addition, their body size is seen as an advantage because less amount of water is required for digestion. Farmers found it easier to feed the aforesaid animals compared to large ones. Goats can climb into trees or shrubs to consume the desired forage, something large ruminants cannot do. To save their livestock, some farmers resorted to pumping water from boreholes for their animals. Farmers made wooden drinking trough (narrow open container in which water for animals was put) and poured water inside from the boreholes. This strategy prevented farmers from travelling long distances to search for water. Some opted to temporarily migrate to Kafue flats in the lean season where water and forage was readily available.

There were very few dams and boreholes in the chiefdom. Dams did not store enough water to last up to the next rain season due to recurrent drought. Residents of Siachitema did not have knowledge of water harvesting, a strategy that can help them ameliorate the impacts of climate change.

#### **5.4.2. Off-Farm**

Off-farm activities were not common in Siachitema Chiefdom. There were very few smallholder farmers who did piece works in other people's farms. Those who did were either paid in kind or in monetary form after doing some piecework. Women and children were mostly in charge of off-farm activities. They harvested crops and removed weeds in other people's fields and got either bag of maize, mealie-meal or money in return. This strategy was mostly done in the farming season and harvesting period. In the lean season, people concentrated on non-farm activities and preparing for the next farming season. Smallholder farmers concentrated more on on-farm and non-farm, particularly on the former.

#### **5.4.3 Non-Farm**

This strategy was second to on-farm in combating effects of climate change in Siachitema. Non-farm income generating activities were considered to be an essential component of livelihood diversification strategy in Siachitema to combat climate change shocks. Smallholder farmers were compelled to indulge in non-farm activities due to the decline in agricultural yields. This trend of adopting non-farm activities in response to climate change shocks has been evidenced by Mubanga and Umar (2014) who revealed that smallholder farmers in Chipepo were engaged in off-farm and non-farm activities to reduce impacts of rainfall variability impeding their agriculture. Smallholder farmers in Siachitema ventured into non-farm activities to generate additional income to that which they got from on-farm. Some farmers migrated to nearby or distant cities to look for temporal jobs. The income generated from piece works was used to buy food and farming inputs. This strategy was only employed during the lean season, on the eve of the farming season, the migrants returned home to work on their farms. Migration was selective as only able-bodied men migrated to urban areas. The women, children and old people remained behind to take care of homes. Although the money generated from this strategy is not much, it still makes significant contribution in combating climate change impacts. Some households relied on remittances. Their

relatives from urban areas sent money for them to buy food and other necessities, a pure form of rural-urban linkage. This is evidenced by findings from Gopal et al (2015) who revealed that people in the indo-gangetic region have diversified their livelihoods through remittances and wage earning in several sectors. Brick molding was another strategy residents of Siachitema employed to ameliorate impacts of climate change. They molded bricks and sold them to nearest urban areas, mostly Choma and Kalomo. Most people in the aforementioned towns prefer burnt bricks when building as they are cheaper than cement blocks. This preference for bricks is an income generating opportunity for the people of Siachitema. The income generated from brick molding was also used to buy food and farming inputs. Some farmers were engaged in brick laying in the off-season to generate income, although the adoption rate of this strategy was low (21%).

Charcoal production was an important livelihood diversification strategy among residents of Siachitema. Farmers looked beyond their farms and turned to their environment for charcoal burning as it guaranteed continuous flow of income during the lean season. The assured flow of income from this strategy comes as a result of high charcoal demand in urban areas. The high levels of energy poverty in urban areas create high demand for charcoal, largely at the expense of the chiefdom's forests and woodlands. Farmers produced as many as fifty bags of charcoal which they sold to nearby towns. Others transported their charcoal to Lusaka city where there is extremely high demand and sold one bag at two hundred or two hundred fifty kwacha. Despite the warnings from forest department to stop charcoal production, farmers vowed not to stop producing charcoal because it gives them income to buy food. The farmers are fully aware of the repercussions of cutting down trees for charcoal production but they have no option because they need to generate income for food. These findings are consistent with other studies. For example, Paavola (2004) found that households in Morogoro region tapped natural resources to manufacture charcoal and harvest timber in response to climatic changes that threatened their rain-fed agriculture.

To diversify their livelihoods out of agriculture, people adopted petty trading to increase their income. This strategy was common in Siachitema and it was mostly carried out by women. Men were equally engaged in petty trading; however, it was women who were mostly found engaging in business. In some cases, children were also involved in trading especially during school holidays. Petty traders engaged in sale of clothes (these were second hand clothes), fritters (locally

known as Hitumbuwa), books, salt and cooking oil which they sold in very small and affordable quantities. These findings agree with Mubanga and Mbewe (2020) revelation that smallholder farmers in Chongwe were engaged in petty trading as a way of responding to climate change. Petty trading changed the rural economy of Siachitema as it improved the availability of goods and services. People easily accessed and bought goods in smaller units without going to town. The advantage of this livelihood strategy is that it requires small amount of money to kick-start. Petty trading was a success and it helped them in so many ways. However, the income generated from trading was inadequate to cater for various needs of the household. The involvement of women in petty trading is good because it improves and sharpens their entrepreneurship skills. Women made significant contribution to household income and it is also good for their wellbeing. Men were mostly engaged in traditional beer trading. A common trade in Siachitema which generated good profit whether at night or during day time. This trade was never short of customers because consumers could cover long distances to go and drink. The residents of Siachitema exhibited immense potential to flourish in business but lack of capital is a huge obstacle to this strategy. If government and other actors of rural development can start providing soft loans at low interest, farmers, especially women can generate huge income from this diversification strategy.

Combating climate change impacts was a continuous process in the chiefdom of Siachitema. Smallholder farmers came to terms with the fact that they could no longer rely on agriculture for their livelihoods. Farmers did not hide their frustrations about the impact climate change had on their lives. There were efforts by some farmers to engage in village banking, a microcredit methodology whereby financial services are administered locally rather than centralized in a formal bank. Though not a common livelihood strategy in Siachitema, those who were doing it expressed satisfaction. Due to limited capital and doubtfulness about the scheme, there was low investment in this business. However, the little capital that farmers invested gave them reasonable profit. With the right and adequate knowledge about village banking, farmers can generate impressive profit from the business. Many farmers are still skeptical about it, obviously their fear is generated from stories they hear about people losing money in urban areas through the same scheme.

The social cash transfer which government introduced some years back made significant contribution in combating climate change impacts. This is a regular, non-contributory payments of money provided to incapacitated individuals and households. Persons aged 65 years and above as well as those with severe limitation activity. Beneficiary households are entitled two hundred kwacha per month, which they receive every two months as a sum of four hundred kwacha. Households with a member with severe activity limitation receive double amount, four hundred kwacha per month and eight hundred kwacha every two months. This was used as a strategy by smallholder farmers to ameliorate the impacts climate change has on their livelihoods. The money was used to buy food and other necessities of life. Households that had more than one beneficiary benefitted more and were in good position to combat impacts of climate change better than those who did not have beneficiaries. They were assured of income every two months from the government which they used wisely.

#### 5.4.4 Contribution of Livelihood Diversification Strategies to Climate Change Resilience

As shown in table 7, there was a statistically significant difference (0.001) in contribution of different livelihood diversification strategies to climate change resilience.

Table 7. ANOVA test for the Contribution of Livelihood Diversification Strategies to Climate Change Resilience

|                | Sum Of Squares | DF  | Mean Square | F        | Sig.  |
|----------------|----------------|-----|-------------|----------|-------|
| Between Groups | 3521.910       | 2   | 1760.955    | 1141.801 | 0.001 |
| Within Groups  | 920.730        | 597 | 1.542       |          |       |
| Total          | 4442.640       | 599 |             |          |       |

Source: Field Data: 2022

A pairwise comparison of livelihood diversification strategies' contribution to climate change resilience was made (Table 8). There was a statistically significant difference in contribution to climate change resilience between on-farm and off-farm (0.001), between on-farm and non-farm (0.001). The groups' contribution to climate change resilience was not the same. Despite the severe impact of climate change on crop and livestock farming in Siachitema chiefdom, on-farm

strategies contributed more to climate change resilience than the other two strategies. Investment in their farms yielded a positive outcome and the more they diversified their livelihood on-farm, the better the outcome. Non-farm strategies were second in contributing to resilience, the least was off-farm strategies.

Table 8. Multiple Comparisons of Livelihood Diversification Strategies' Contribution to Climate Change Resilience

| Livelihood Strategies | Livelihood Strategies | Mean Difference | Std. Error | P. Value |
|-----------------------|-----------------------|-----------------|------------|----------|
| On-farm               | Off-farm              | 5.835*          | .124       | .000     |
|                       | Non-farm              | 3.855*          | .124       | .000     |
| Off-farm              | On-farm               | -5.835*         | .124       | .000     |
|                       | Non-farm              | -1.980*         | .124       | .000     |
| Non-farm              | On-farm               | -3.855*         | .124       | .000     |
|                       | Off-farm              | 1.980*          | .124       | .000     |

\*. The Mean Difference is Significant at the 0.05 Level.

Source: Field Data Source: 2022

The diversification strategies made significant contribution in increasing people's resilience to climate change impacts. Agriculture extension officers explained that when compared to days of yesteryear, it could be safe to say that the strategies adopted by residents of Siachitema such as conservation agriculture, drought tolerant crops, and early maturing varieties have made a meaningful contribution in making them resilient to the impact of climate change by increasing food per household and income, though there is more that could be done to increase and strengthen their resilience. From the time farmers started diversifying their livelihoods, the impacts of climate change have been ameliorated. Farmers expressed happiness with the steps they made towards making themselves resilient against the impact of climate change. They made changes to farming practices in response to different stresses. Livelihood diversification strategies contributed to nearly sixty percent resilience to climate change. Smallholder farmers are receiving support from

Non-Governmental Organizations and World Food Programme through their implementing partners ADRA by giving those species of crops that matured early and tolerant to drought varieties. Such diversification made farmers resilient to impacts of climate change. Further, crop diversification improved the soil and reduced soil degradation. With more support from actors of rural development such as the state, non-governmental organizations and international development agencies, farmers in Siachitema can realize their longstanding dream of becoming fully resilient to climate change. They are open and willing to embrace new livelihood diversification strategies.

### 5.5 To Analyze the Contribution of Livelihood Diversification Strategies to Household Food Security

Table 9 shows that there was a statistically significant (Overall) group difference (0.001) in contributing to household food security between livelihood diversification strategies. The groups' contribution to food security at household level was not the same.

Table 9. ANOVA Test for the Contribution of Livelihood Diversification Strategies to Household Food Security in Siachitema

|                | Sum of Squares | DF  | Mean Square | F       | Sig.  |
|----------------|----------------|-----|-------------|---------|-------|
| Between Groups | 3122.123       | 2   | 1561.062    | 932.691 | 0.001 |
| Within Groups  | 999.210        | 597 | 1.674       |         |       |
| Total          | 4121.333       | 599 |             |         |       |

Source: Field Data: 2022

Another pairwise comparison of livelihood diversification strategies' contribution to household food security was made (Table 10). There was significant difference in contribution to food security at household level between on-farm and off-farm (0.001), between on-farm and non-farm (0.001), between off-farm and non-farm (0.000). The adopted strategies' contribution to food security was not the same. On-farm livelihood strategies contributed more to food security than the other strategies. Farmers believed that diversifying on farms was still a better option that could

make them food secure. The on-farm strategy received more attention compared to the other two strategies.

Table 10. Multiple Comparisons of Livelihood Diversification Strategies Contribution to Household Food Security

| Livelihood Strategies |          | Mean Difference | Std. Error | P. Value |
|-----------------------|----------|-----------------|------------|----------|
| On-Farm               | Off-Farm | 5.515*          | .129       | .000     |
|                       | Non-Farm | 3.535*          | .129       | .000     |
| Off-Farm              | On-Farm  | -5.515*         | .129       | .000     |
|                       | Non-Farm | -1.980*         | .129       | .000     |
| Non-Farm              | On-Farm  | -3.535*         | .129       | .000     |
|                       | Off-Farm | 1.980*          | .129       | .000     |

\*. The Mean Difference is Significant at the 0.05 Level. Source: Field Data: 2022

Food security in Siachitema chiefdom is a chronic problem and the situation may not change any time soon without intensification of livelihood diversification strategies. It is important to note that the economy of Siachitema is largely driven by agriculture, a livelihood that is severely affected by climate change. Although smallholder farmers are not food secure, the adopted strategies made significant contribution to household food security. Extension officers disclosed that diversification helped farmers to improve their food security situation by 60% better than it was before they started diversifying. There was satisfaction with the adopted livelihood strategies particularly on-farm. Diversification of crops in particular had a positive and significant effect on household food security. It improved food security by increasing food stocks in terms of quantity and variety. Additionally, it improved income through sale of crops which were produced from a variety of crop species. These findings correspond with Umar and Nyanga (2011) who revealed that conservation agriculture made a significant difference in crop yields and subsequently food security for households. Crop diversification was a reliable strategy for smallholder farmers in Siachitema as it improved food availability and farm level crop productivity. There is too much

reliance on crop production which means that residents of Siachitema are fixated on crop farming as the only means of ensuring household food security.

Income generated from non-farm activities was invested on farms to increase agricultural production and used to buy food during critical periods, from October to March. This was the most critical period according to the residents, so income from this strategy helps them to survive during the aforementioned period. As mentioned earlier, non-farm farm activities were popular in the lean season, an indication that there was little amount of effort and investment to harness the potential of non-farm livelihood. This strategy was deserted in the farming season as farmers fully concentrated on farming. The seasonal attentiveness to the aforementioned livelihood strategy in Siachitema implies minimal contribution to household food security. There is urgent need to intensify livelihood diversification strategies both on-farm and non-farm in order to realize food security at household level. Diversification of livelihoods is the finest decision that helped smallholder farmers to improve their food security situation, income as well as reducing vulnerability to shocks. If residents of Siachitema are to be fully food secure, actions by different stakeholders are needed in the short term to enable responses in the short, medium and long term. There is urgent need for a paradigm shift towards agriculture and food systems that are more resilient, more productive, and more sustainable. This will go a long way in eliminating hunger and ameliorating climate change impacts, and keep these impacts at levels where smallholder farmers can still be food secure.

## **CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS**

### **6.1 Introduction**

This Chapter concludes the findings of the study on livelihood diversification strategies to combat impacts of climate change in Siachitema chiefdom. Recommendations on how the adopted livelihood strategies can be improved and strengthened in order to increase people's resilience to climate change impacts are also outlined.

### **6.2 Conclusion**

The study has clearly shown that the livelihoods of smallholder farmers Siachitema chiefdom are affected by impacts of climate change. Changes in climate has an impact on the livelihoods of farmers through recurrent drought, high temperatures and occasional floods. There has been a reduction of yields from on-farm activities and a severe impact on livestock farming. To combat impacts of climate change and climate variability, smallholder farmers resorted to diversifying their livelihoods in order to increase income generation and ensure sustainability. The diversification strategies were on-farm, non-farm and off-farm. These strategies increased people's resilience to climate change impacts and made significant contribution to food security. There is urgent need to sensitize and encourage farmers in Siachitema chiefdom to adopt conservation farming methods. This type of agriculture will make them more resilient to climate change and ensure sustainability. There is also need to encourage farmers to invest more in non-farm activities so as to compliment agricultural activities. The strategies adopted made a significant contribution to household food security. If the adoption rate of conservation agriculture can increase, Siachitema chiefdom can be food secure. Women must be part and parcel of combating impacts of climate change as they are the most vulnerable to climatic changes. Sidelining them would cause more harm to their well-being. Without serious livelihood diversification strategies, climate change will push thousands of farmers in Siachitema further into poverty and limit the opportunities for sustainability and for people to escape poverty

### 6.3 Recommendations

In view of the research findings, the following recommendations are made:

1. There is need to increase the distribution of magoye rippers by government and other actors of rural development in Siachitema. This will promote conservation farming and increase people's resilience to climate change effects. Currently, the number of rippers in the chiefdom is small and cannot meet the demand
2. There is need by Government to construct more dams, drill enough boreholes and equip farmers with knowledge of water harvesting. This will enable them to grow crops and guarantee gardening throughout the year. This will also mean availability of water for livestock throughout the year.
3. Government should urgently employ more veterinary officers and construct dip tanks to eliminate animal diseases. Majority of residents in Siachitema are into livestock farming yet there are no dip tanks in the chiefdom.
4. The actors of rural development such as International Development Agencies, Private Sector, Non-Governmental Organizations as well as Government should be supplying farming inputs to farmers early enough to enable them plant at the onset of the farming season. There is also need to consider reducing and/or subsidizing prices of inputs especially early maturing and drought tolerant seeds. This will go a long way in combating impacts of climate change in the chiefdom.
5. Government through Ministry of local Government and rural development should support the non-farm strategies such as petty trading by providing soft loans with low interest. This could increase farmers' resilience to climate change shocks.
6. The World Bank through its implementing partners ADRA and Government should introduce more methods of conservation farming and encourage farmers who are still fixated on conventional type of farming to adopt this conservation method. Conservation farming has so far proven to be effective in combating impacts of climate change.

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## APPENDICES

### APPENDIX 1

#### SEMI-STRUCTURED INTERVIEWS FOR SMALLHOLDER FARMERS

Topic: LIVELIHOOD DIVERSIFICATION TO COMBAT IMPACTS OF CLIMATE CHANGE  
IN SIACHITEMA CHIEFDOM, KALOMO DISTRICT, ZAMBIA.

#### INTRODUCTION

My name is Derrick Tembo Bwalya, from the University of Zambia. I am a Masters student in the school of Natural Sciences, Department of Geography and Environmental Studies. I am conducting a research on; Livelihood Diversification to Combat Impacts of Climate Change in Siachitema Chiefdom. You have been chosen as one of the respondents in this study. You are therefore, kindly requested to answer the questions in this study. Your participation in this research is voluntary, so you are free to withdraw from the study at any time. The information gathered in this interview will only be used for purposes of research. Should you have any questions regarding this study, feel free to ask.

#### SECTION A-PERONAL INFORMATION

1. Age [     ]

2. Gender

Male [     ] Female [     ]

3. Marital Status

Never Married [     ] Monogamously Married [     ]

Polygamously Married [     ] Divorced [     ]

Separated [     ] Widowed [     ]

Cohabiting [    ]

4. Level of Education

Primary [    ]      Secondary [    ]      Tertiary [    ]

Never Attended [    ]

5. Number of years spent in formal education

[            ]

6. Occupation

[                            ]

SECTION B- SEVERITY OF IMPACTS OF CLIMATE CHANGE ON COMMON LIVELIHOODS

1. What livelihoods are common among residents of Siachitema Chiefdom?

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2. What are the impacts of climate change on the identified common livelihoods?

(i) Crop farming

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(ii) Livestock

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(iii) Other common livelihoods

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3. How severe are the impacts of climate change on crop farming.

1.     Very severe           [    ]  
2.     Severe               [    ]  
3.     Moderate            [    ]  
4.     Not Severe          [    ]

4. Explain your reasons for the rating in Q3

5. How severe are the impacts of climate change on livestock

1. Very severe      [    ]

2. Severe            [    ]

3. Moderate        [    ]

4. Not severe       [    ]

6. Explain your reasons for the rating in Q5

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7. How severe are the impacts of climate change on other livelihoods

1. Very severe            [    ]

2. Severe                [    ]

3. Moderate              [    ]

4. Not severe            [    ]

10. Explain your reasons for the rating in Q9

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SECTION C- LIVELIHOOD DIVERSIFICATION STRATEGIES ADOPTED BY RESIDENTS  
OF SIACHITEMA CHIEFDOM

1. What livelihoods diversification strategies have you adopted to combat impacts of climate change?

(i) On-Farm-----

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(ii) Off-Farm (Within Agriculture)-----

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(iii) Non-Farm-----

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2. On a scale of 1-10, with 1 being the least and 10 being the highest, to what extent have each of the livelihood diversification strategies contributed to your resilience to impacts of climate change

(i)On-farm            [       ]

(i)Off-farm           [       ]

(i)Non-farm           [       ]

3. Explain the reasons for your rating in Q2

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4. How has the livelihood diversification strategies mentioned in Q1 contributed to your resilience to climate change impacts?-----

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#### SECTION D-CONTRIBUTION OF LIVELIHOOD DIVERSIFICATION STRATEGIES TO HOUSEHOLD FOOD SECURITY IN SIACHITEMA

1. On a scale of 1-10, with 1 being the least and 10 being the highest, to what extent do livelihood diversification strategies contribute to household food security?

(i) On-farm            [         ]

(ii) Off-farm         [         ]

(iii) Non-farm        [         ]

2. Explain the reasons for your rating in Q1.

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3. How has the livelihood diversification strategies you have adopted contributed to your household food security?

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SECTION E-SUSTAINABLE STRATEGIES FOR RESILIENT LIVELIHOODS IN  
SIACHITEMA CHIEFDOM

1. What sustainable strategies can make you to be climate resilient?

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2. How can livelihood diversification strategies you have adopted be improved and strengthened in order to increase your resilience to impacts of climate change?

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## APPENDIX 2

### KEY INFORMANTS INTERVIEWS

TOPIC: LIVELIHOOD DIVERSIFICATION TO COMBAT IMPACTS OF CLIMATE CHANGE IN SIACHITEMA CHIEFDOM, KALOMO DISTRICT, ZAMBIA.

### INTRODUCTION

My name is Derrick Tembo Bwalya, from the University of Zambia. I am a Masters student in the school of Natural Sciences, Department of Geography and Environmental Studies. I am conducting a research on; Livelihood Diversification to Combat Impacts of Climate Change in Siachitema Chiefdom. You have been chosen as one of the key persons knowledgeable about issues of livelihood diversification in the aforementioned chiefdom. You are therefore, kindly requested to answer the questions in this study. Your participation in this research is voluntary, so you are free to withdraw from the study at any time. The information gathered in this interview will only be used for purposes of research. Should you have any questions regarding this study, feel free to ask.

1. What has been the impacts of climate change on crop farming, livestock and natural resources in Siachitema Chiefdom?

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2. What on-farm strategies have been adopted by residents of Siachitema Chiefdom to combat impacts of climate change?

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3. What off-farm strategies have been adopted by residents of Siachitema Chiefdom to combat impacts of climate change?

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4. What non-farm strategies have been adopted by residents of Siachitema Chiefdom to combat impacts of climate change?

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5. How has livelihood diversification contributed to residents' resilience to climate change impacts?

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6. What is your assessment on the contribution of livelihood diversification strategies on household food security?

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7. What support has been rendered by government and non-governmental organizations to the residents of Siachitema Chiefdom to improve, strengthen and make their livelihood diversification strategies sustainable?

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8. What recommendations would you make to Government, NGOs, International Development Agencies and other actors of rural development on how to strengthen, improve and make livelihood diversification strategies sustainable in order to increase people's resilience to impacts of climate change?

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## APPENDIX 3



### THE UNIVERSITY OF ZAMBIA DIRECTORATE OF RESEARCH AND GRADUATE STUDIES

Great East Road Campus | P.O. Box 32379 | Lusaka10101 | Tel: +260-211-290 258/291 777 Fax: (+260)-211-290 258/253 952 | E-mail: [director.drugs@unza.zm](mailto:director.drugs@unza.zm) | Website: [www.unza.zm](http://www.unza.zm)

#### APPROVAL OF STUDY

**IORG No. 0005376**

**HSSREC IRB No. 00006464**

20<sup>th</sup> September, 2022

**REF NO. HSSREC-2022-JUL-029**

Derick Tembo Bwalya P.  
The University of Zambia  
School of Natural Sciences  
P.O. Box 32379

**LUSAKA**

Dear Mr. Derick Tembo Bwalya P.,

**RE: “LIVELIHOOD DIVERSIFICATION TO COMBAT IMPACTS OF CLIMATE  
CHANGE IN SIACHITEMA CHIEFDOM, KALOMO DISTRICT”**

Reference is made to your submission of the protocol captioned above. The HSSREC resolved to approve this study and your participation as Principal Investigator for a period of one year.

| REVIEW TYPE               | ORDINARY REVIEW                                    | APPROVAL NO.<br>HSSREC-2022-JUL-029              |
|---------------------------|----------------------------------------------------|--------------------------------------------------|
| Approval and Expiry Date  | Approval Date:<br>20 <sup>th</sup> September, 2022 | Expiry Date:<br>19 <sup>th</sup> September, 2023 |
| Protocol Version and Date | Version - Nil.                                     | 19 <sup>th</sup> September, 2023                 |

|                                               |                |                |
|-----------------------------------------------|----------------|----------------|
| Information Sheet,<br>Consent Forms and Dates | □ English.     | To be provided |
| Consent form ID and Date                      | Version - Nil  | To be provided |
| Recruitment Materials                         | Nil            | Nil            |
| Other Study Documents                         | Questionnaire. |                |
| Number of Participants<br>Approved for Study  |                |                |

Specific conditions will apply to this approval. As Principal Investigator it is your responsibility to ensure that the contents of this letter are adhered to. If these are not adhered to, the approval may be suspended. Should the study be suspended, study sponsors and other regulatory authorities will be informed.

### CONDITIONS OF APPROVAL

- No participant may be involved in any study procedure prior to the study approval or after the expiration date.
- All unanticipated or Serious Adverse Events (SAEs) must be reported to HSSREC within 5 days.
- All protocol modifications must be approved by HSSREC prior to implementation unless they are intended to reduce risk (but must still be reported for approval). Modifications will include any change of investigator/s or site address.
- All protocol deviations must be reported to HSSREC within 5 working days.
- All recruitment materials must be approved by HSSREC prior to being used.
- Principal investigators are responsible for initiating Continuing Review proceedings. HSSREC will only approve a study for a period of 12 months.
- It is the responsibility of the PI to renew his/her ethics approval through a renewal application to HSSREC.
- Where the PI desires to extend the study after expiry of the study period, documents for study extension must be received by HSSREC at least 30 days before the expiry date. This is for the purpose of facilitating the review process. Documents received within 30 days after expiry will be labelled “late submissions” and will incur a penalty fee of K500.00. No study shall be renewed whose documents are submitted for renewal 30 days after expiry of the certificate.
- Every 6 (six) months a progress report form supplied by The University of Zambia Humanities and Social Sciences Research Ethics Committee as an IRB must be filled in and submitted to us. There is a penalty of K500.00 for failure to submit the report.

- When closing a project, the PI is responsible for notifying, in writing or using the Research Ethics and Management Online (REMO), both HSSREC and the National Health Research Authority (NHRA) when ethics certification is no longer required for a project.
- In order to close an approved study, a Closing Report must be submitted in writing or through the REMO system. A Closing Report should be filed when data collection has ended and the study team will no longer be using human participants or animals or secondary data or have any direct or indirect contact with the research participants or animals for the study.
- Filing a closing report (rather than just letting your approval lapse) is important as it assists HSSREC in efficiently tracking and reporting on projects. Note that some funding agencies and sponsors require a notice of closure from the IRB which had approved the study and can only be generated after the Closing Report has been filed.
- A reprint of this letter shall be done at a fee.
- All protocol modifications must be approved by HSSREC by way of an application for an amendment prior to implementation unless they are intended to reduce risk (but must still be reported for approval). Modifications will include any change of investigator/s or site address or methodology and methods. Many modifications entail minimal risk adjustments to a protocol and/or consent form and can be made on an Expedited basis (via the IRB Chair). Some examples are: format changes, correcting spelling errors, adding key personnel, minor changes to questionnaires, recruiting and changes, and so forth. Other, more substantive changes, especially those that may alter the risk-benefit ratio, may require Full Board review. In all cases, except where noted above regarding subject safety, any changes to any protocol document or procedure must first be approved by HSSREC before they can be implemented.

Should you have any questions regarding anything indicated in this letter, please do not hesitate to get in touch with us at the above indicated address.

On behalf of HSSREC, we would like to wish you all the success as you carry out your study.

Yours faithfully,



*Dr. J. I. Ziwa*

**DR. J. I. Ziwa**

**ACTING CHAIRPERSON THE UNIVERSITY OF ZAMBIA HUMANITIES AND SOCIAL SCIENCES RESEARCH ETHICS COMMITTEE - IRB**

**CC:** Director, Directorate of Research and Graduate Studies

Assistant Director (Research), Directorate of Research and Graduate Studies  
Registrar (Research), Directorate of Research and Graduate Studies

Assistant