

An Assessment of the Effects of Climate Change Pattern on Food Security and the Coping Strategies of the Rural Communities in Monze District of Zambia

Bornface Mafwela¹, Prof. Dominic Byarugaba (PhD)², Prof. John Bwalya (PhD)³

¹United Church of Zambia Synod, Zambia

^{2,3}University of Lusaka, Zambia

Abstract: This research is based on ‘assessing the effects of the changing climate pattern on food security in Monze district of Southern province of Zambia’. Its main purpose was to investigate compatibility issues related to improved crop varieties and how resilient the local community of Monze district in Southern province of Zambia respond to shocks as a result of changes in climate pattern. The study was guided by the following main research question ‘What are some of the compatibility issues related to improved crop varieties and how do indigenous people respond to the effects of climate change in Monze district of Southern part of Zambia?’

Both primary and secondary data were employed to collect the data used for analysis to birth this thesis. Data was gathered using semi-structured interviews, focus group interviews, weight measurement of the U5s, and content analysis. Content analysis is a method of qualitative data analysis. Research participants included: key informants obtained from community leaders as well as officials from the Ministry of Agriculture & Cooperatives, Ministry of Lands and Natural resources, Ministry of National Planning & Budgeting under the department of Climate Change, women and men drawn from the emerging and small-scale farmers. Relevant literature from books, academic papers, journals, newspapers and the internet were used. Descriptive and inferential statistics were used to interpret and further explain the facts on changing climate patterns and the security of food.

The results show that the district of Monze has been experiencing severe climatic changes making the inhabitants to initiate other several coping mechanisms. On the other hand, the results show that the rural dwellers of Monze district continued for over 3 years experiencing fluid food security (not static) and that 83 percent of this rural district had their food nutrition compromised. This is because most of the rural communities rely more on rain fed agriculture for survival, and in times when food was insecure, they opted to charcoal burning for sale, sending their children to other relatives in big cities for school, men marry several wives as cheap labour and opt to heavy drinking habits. Based on these findings, the study concluded that mean annual temperature and rainfall were not the main determinants of the rural household food security situation in Monze district. To deal with this contribution of effects of climatic change on food security, the study recommends that rural households begin to adopt other crops other than maize that can perform well under the prevailing climatic conditions. It is further recommended that the rural dwellers of Monze district should embark on other alternative ways of livelihoods and also

consider running their agriculture enterprises as a business venture (typically for profit).

Key terms: Changing climate patterns, the security of food, Climate change, Food insecurity, Household food security, Food systems

I. INTRODUCTION AND BACKGROUND OF THE STUDY

1.1 Introduction

This chapter presents the introduction and background of the study. This chapter begins with a descriptive definition of the main concepts of the changing climate patterns and the security of food in Zambia specifically Monze district.

1.2 Background to the study

Climate change is a crossing-cutting issue which the Government of the Republic of Zambia (GRZ) like any other government of the world has embarked on in ensuring that food is secure at the household level. The GRZ is promoting among other policies the Fertiliser Support Program (FSP) and the Farmer Input Support Program (FISP) as a way of cushioning the small-scale and emerging farmers in the Agro-input acquisition through subsidised prices.

The research takes an interesting turn as it investigates the effects of local knowledge practices on food security in Monze district (Bukusuba and Gadaga, 2009). The rural dwellers of Monze district experience other challenges as well other than climatic ones all affecting food security at household level. These comprise the distribution of inputs, government policy, and transportation of produce and availability of markets for the produce. This study concerned merely on extrapolating the effects of scientific monitors (technology) on food security. It should also be noted that there are several climatic factors with the potential to affect food production and hence the security of food. This study only concentrated on extrapolating the effects of scientific monitors (technology) on food security at the household level especially in Monze district of Zambia. This is because, as discussed by Sowunmi and Akintola (2010), technology and scientific interventions among others, are important factors that influence crop production and the overall probability of

these factors is imperious for each day and medium-term planning of farming operations.

1.3 Background to the Problem

The changing climate patterns are perhaps the most fatal environmental threats to the fight against food insecurity in sub-Saharan Africa. This is for the distress food systems in several ways ranging from direct effects on crop production (e.g., changes in rainfall causing drought or flooding, or warmer or cooler temperatures triggering changes in the growing's length season), because of changes in markets, food prices and supply chain infrastructure. Without doubt, they provide an environmental threat to the security of food because of their effect on agricultural output. This is because virtually all sectors of agriculture rely on weather and climate whose erosion has meant that rural farmers encounter total failure (Ozor *et al.*, 2010).

The latest thrilling occurrence in relation to floods happened in the year 2007/2008 rainy season, affecting a wide geographical area in the country (ZVAC, 2008). Amid the years 2002 and 2007, Zambia experienced two massive floods (Year 2002/2003 and Year 2006/2007) (GRZ, 2007). The country additionally experienced gigantic flooding in the years 2008/9 and 2009/10. DMMU (2007) (in GRZ, 2007) stated that the 2007 floods affected 41 out of 72 districts in Zambia which included areas never affected by floods over the years. Ancient data proves that recent floods have been more widespread and more frequent and, in some years, too early in areas where they are late.

1.4 Statement of the Problem

Over the years since 2001/2002 production season Zambia has been recording a maize deficit. Though there were surpluses in other crops, its food security situation is serious; whichever measure of the security of food one uses. The average percentage of household income spent on food is rising, showing that Zambia households are finding it increasingly difficult to feed themselves (UNDP, 2008).

The other views are that there has been a decline occasioning from the collapse of copper mining in Zambia as international demand has fallen (Ferguson, 1999) and from the impact of the Zambian Structural Adjustment Programme (SAP). Human survival in Zambia has become more and more difficult as incomes continue to deteriorate exposing Zambia experience harsh economic and social glitches resulting in deteriorating living standards and conditions for most of the people ever since the 1970s. Also forming part of the problem is that owing to the changes in climate pattern that have been experienced over the years, most Zambians, especially rural dwellers bear the effects of food challenges. (Nelson, Rosegrant, Robertson, *et al.* 2009).

The overall research problem addressed in this study is that despite an increase in the number of research on effects of climate change and food security at household level globally, little has been done to analyse these effects on the

communities of Monze and how they build shock absorbers. Studies carried by the Intergovernmental Panel on Climate Change [IPCC] 2007; Vogel 2005; World Bank 2016) indicates that Africa (where Zambia is) is highly vulnerable to the changes in climate pattern. This means that climate change has a severe impact on agricultural land, which ultimately affects food security. The climate pattern has been increasingly impacting food security in parts of the world, worse of it in Sub Saharan Africa (SAA) where Zambia (research site) is. It is indeed true that Africa is being epitomised as the most vulnerable continent to changes in climate pattern (Bwalya 2013). The IPCC (2007) projects that in sub-Saharan Africa; agricultural productivity will decline from 21% to 9% by the year 2080. Nevertheless, the growth of the global population has continued rising and the rates at which climate change and production of agriculture and food have been increasing are unequal.

1.5 Research Aim, Objectives & Questions

General Objective, Specific Objectives and Research Questions as follows:

1.5.1 General Objective

To investigate the changing climate patterns and its effect on the security of food in rural households of Monze district of Zambia

1.5.2 Research Objectives

- 1) To determine effects of local knowledge practices on food security in Monze district
- 2) To extrapolate the effects of scientific monitors (technology) on food security in Monze district
- 3) To identify strategies that rural households in Monze district are using to help mitigate potential effects of changing climate pattern on food security.
- 4) To assess compatibility issues related to improved crop varieties and local community perceptions in uptake to grow, consume and increase the marketability of new products.

1.5.3 Research Questions

- 1) What are effects of local knowledge practices on food security in Monze district?
- 2) What are the effects of scientific monitors (technology) on food security in Monze district?
- 3) What are the strategies that rural households in Monze district are using to help mitigate potential effects of changing climate pattern on food security?
- 4) How are compatibility issues related to improved crop varieties and local community perceptions in uptake to grow, consume and increase the marketability of new products?

1.6 Significance of the Study

The knowledge gained from the study may also help in enhancing the development of farming practices which are

inherently sensitive to climate conditions and manage farming as a business entity an intervention of reducing poverty levels to improve the standard of living of the rural populace.

The Zambian government to come up with operational strategies and interventions in response to food security and how it effects climate change patterns and food security discrepancy, especially in rural areas such as Monze district of Zambia reducing further is one of the most vulnerable sectors to the risks and impacts of global changing climate patterns. Chisanga and Masiye (1998), attempted to suggest that food production and availability should be a priority area for governments across the globe, if the elusive agenda of globally, the food security is to be realised unscathed. This is because climate change patterns directly affect agricultural production and therefore the security of food.

This research was worth undertaking not only because it is supported by the literature but also because it is about a topical issue that still poses serious challenges to academics and researchers from all walks of life (Hofstee, 2016). Climate Change is now a cross-cutting issue as it is challenging both mankind and environment; hence, it is vital to mainstream prudent management of the environment. Finally, the study may provide an opportunity for further research.

1.7 Scope and Delimitation of the Study

The study was limited to emerging and small-scale farmers who are on the records of Health Education Programs - Zambia in the 6 chiefdoms of Monze district. The reason for choosing the emerging and small-scale farmers and Monze study area is that the researcher has some experience of the sites. Although the study shall be limited to emerging and small-scale farmers, the findings from these selected sites shall provide significant insights as to how communities adapt to the changing climate pattern and how these communities build shock absorbers.

1.8 Limitations

Limitations in any study are those things that affect or influence the interpretation of findings and tend to make the generalisation of the results very difficult. (Price and Murnan, 2004). It is common knowledge that all studies have limitations. *Limitations for this study were as follows:* -

- i) The Covid-19 pandemic posed a challenge in data collection as interaction with research participants and access to most premises for secondary data collection was restricted.
- ii) Lack of available and/or reliable data on accurate and updated statistics of the changing climate pattern of Zambia is also another limitation.

1.9 Definition of Key terms

1.9.1 Changing climate patterns

The term changing climate patterns is defined as a change in the statistical distribution of weather patterns when that

change lasts for an extended period of time (i.e., decades to millions of years). Climate change is caused by factors such as biotic processes, variations in solar radiation received by Earth, plate tectonics, and volcanic eruptions. Certain human activities have been identified as primary causes of on-going climate change, often referred to as global warming (IPCC, 2007; Hegerl *et al.*, 2007).

1.9.2 Climate change

EPA (2004) referred to climate change as any significant change in measures of climate (such as temperature, precipitation, or wind) lasting for an extended period (decades or longer).

1.9.3 Food insecurity

Food insecurity is a household situation when a person is unable to acquire an adequate quantity of healthy food on a daily basis. Consequently, households suffer from chronic hunger and poor nutrition, and are, consequently, less likely to have healthy and productive lives (Campbell, C.C., 1991).

1.9.4 The security of food

FAO (2002) defined the security of food as the situation when “*all people, at all times have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.*”

The security of food can also be said to be a situation where all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life.

1.9.5 Food systems

Food systems encompass activities related to the production of food; and the outcomes of these activities contributing to the security of food (FAO, 2008).

1.9.6 Household

Pewo (1985) describes a household as a unit of production, consumption and socialization feeding from family pot.

1.9.7 Household the security of food

Household food security is defined as access by all households at all times to adequate, safe, and nutritious food for a healthy and productive life (Aluoko and Odingo, 2006; Bonti-Ankomah, 2001)

1.9.8 Traditional knowledge

Traditional knowledge often refers to a more generalized expression of knowledge associating a people or peoples with ‘time-honoured’ ideas and practices associated with an individual or family (Ryser 2011; WIPO 2012).

1.9.9 Indigenous practices

Indigenous knowledge can be broadly defined as the knowledge that an indigenous (local) community accumulates over generations of living in a particular environment (Ryser RC. 2011; Armstrong *et al.*, 2006).

II. LITERATURE REVIEW

2.1 Introduction

Chapter (two) deals with literature review, discussion of the historical changing climate patterns breakdown in Zambia, the relationship between security of food and changing climate patterns, effects of the security of food, anticipated future changing climate patterns, assessing the effects of the changing climate pattern on the security of food in Monze district.

2.2 Overview of the Chapter

The chapter specifically reviews literature correlated to the current study. Ghosh (1992, p.198), did an analysis of related literature, the researcher ‘...*should have the ability to pick and choose the best accessible material, discarding the impractical and superfluous ones...*’ Literature review is vital to any research study since it provides the rational guidelines, ideas or beliefs upon which the research is based. It also offers the researcher with the much-needed understanding of what has been done in the field or subject being studied, how it was done and what suppositions and recommendations were made. It also helps in recognizing the weaknesses and strengths of the research. Furthermore, literature review is important for the reason that it contextualizes the current study by placing it within the context of other analogous studies in order to strengthen it and provide an implication or rationalization for it. In addition, a systematic review of literature helps the researcher to avoid duplication of studies already done on a particular subject.

Adaptation for the rural dwellers of Monze district would mean that there is a shift at the farm household and community scales. Adaptation to climate change at the community level includes also many possible responses, such as changes in crop management practices (e.g. choice of fields, planting dates, planting densities, crop varieties), livestock management practices (e.g. livestock choice, feeding and animal health practices, transhumance timing and destinations), land use and land management (e.g. fallowing, tree planting or protection, irrigation and water harvesting, soil and water conservation measures, tillage practices, soil fertility management) and livelihood strategies (e.g. mix of crops or livestock produced, combination of agricultural and non-farm activities, temporary or permanent migration) (Brklacich *et al.*, 1997; Bryant *et al.*, 2000; Smit and Skinner, 2002; Kabubo-Mariara, 2008).

In the context of climate change and food security, agriculture remains important for ensuring food security and reducing poverty. The agricultural sector has however, been under

threat due to increasing weather variability and climate change and thereby, becoming major barriers to achieving food security and alleviating poverty in this rural district of Zambia. This increase in temperature can be attributed to the effects of agriculture through its impact on cropping seasons, the increase in evapotranspiration, the increase in irrigation requirements and the increasing heat stress on crops. The use of short duration crop varieties and adjustment in sowing time may also reduce the adverse impact of the aforementioned climatic risks.

In order to become resilient to climate change risks in agriculture, emerging and small scale farmers of Monze district use several adaptation strategies, such as an adjustment in sowing time, use of stress-tolerant crop varieties and shifting to new crops (e.g. more stress tolerant, or with shorter or longer crop cycles), could significantly reduce vulnerability to climate change (Smit and Skinner, 2002). Adaptation practices can involve changes in planting dates, fertilizer used, irrigation, plant breed or other aspects of crop management and the cultivation process (Challinor *et al.*, 2014) and have crop specific implications (Porter *et al.*, 2014). These adaptation practices typically reduce risk and are more likely to minimize the severity of the impact of climate change. Thus, farm households using adaptation practices are more likely to be food secure compared to those not adopting.

2.3 The relationship between security of food and changing climate patterns

Sianungu (2015) states that forestry; agriculture and fisheries are all sensitive to climate changes. Their production processes are therefore expected to be affected by changing climate patterns. Generally, effects are likely to be positive in temperate regions and negative in tropical ones, but there are still uncertainly about how anticipated changes play out at the local level, and potential impacts may be altered by the adoption of risk management measures and adaptation strategies that strengthen readiness and resilience.

Mafwela and Muloongo (2010) assert that the effects on all practices of agricultural production affect livelihoods and access to food in households. Producer groups that are less able to deal with changing climatic patterns, such as the rural poor in less developed countries (like Zambia), risk having their safety and welfare compromised. Other food system processes, for instance food processing, acquisition, distribution, preparation and consumption, are as important for food security as food and agricultural production are. Technological developments and the improvement of long-distance marketing chains that move produce and packaged foods throughout the world at high speed and relatively low cost have made overall food system performance far less dependent on climate than it was 200 years ago.

2.4 The link between Security of Food and Economy

Chigunta, Chisanga and Masiye (1998) in their study entitled ‘Poverty Experiences in Zambia’ alludes that Zambia was

economically prosperous at independence (1964), due to the thriving copper industry. Zambia has the potential to expand agricultural production. However, it is estimated that only 14% of total agricultural land is currently being utilized based on the climatic condition of the country. As seen in the national stock and treasury records, Agriculture generates about 22% of Gross Domestic Product (GDP) and provides direct livelihood to more than 50% of the population. The agricultural sector employs 67% of the labour force and it is the main source of income and provides employment for women who make up 65% of the rural population. The sector is currently the main stay of the rural economy.

Mwanaumo (1999) observes that Zambia is among one of the poorest nations in the world despite decades of political stability and freedom from conflict, it is in the same grouping as most war-torn neighbours. The World Bank classifies Zambia as a Least Developed Country. The UNDP *Human Development Report 2001* ranks Zambia 143 out of 161 countries, having fallen consistently over the past years from 136 in 1996, to 142 in 1997, to 146 in 1998. Indeed, of 79 countries for which data is available between 1975 and 1997, Zambia is the only country where the value of the Human Development Index is lower than it was in 1975.

2.5 Effects of the security of food

Mafwela and Muloongo, (2010) postulates that famine and hunger are both grounded in insecurity of food. Severe food insecurity translates into a high degree of vulnerability to famine and hunger; ensuring food security presupposes elimination of that vulnerability. Many nations experience on-going food shortages and distribution problems.

FAO (2008) *postulates that* households are food secure when they have year-round access to the amount and variety of safe foods their members need to lead active and healthy lives. At the household level, food security refers to the ability of the household to secure, either from its own production or through purchases, adequate food for meeting the dietary needs of all members of the household. The nutritional status of each member of a household depends on several situations being met: the food available to the household must be shared according to individual needs; the food must be of adequate variety, quality and safety; and every single family member must have good health status in order to benefit from the food consumed (FAO, 2005).

2.6 Evidence for changing climate patterns

The following section gives a broad overview of climate change, focusing on the evidence, impacts and projected future changes; and then gives a conceptualisation of food security and charts how thinking around food security has broadened over time.

The NAP (2016), reports that the planet's average surface temperature has risen about 1.1^oC since the late 19th century, a change triggered largely by increased carbon dioxide and other human-made emissions into the atmosphere. Most of the

warming occurred in the past 35 years, with 16 of the 17 warmest years on record occurring since 2001. Not only was 2016 the warmest year on record, but eight of the 12 months that make up the year -from January through September, with the exception of June - were the warmest on record for those respective months (NAP, 2016).

2.7 Historical changing Climate patterns breakdown in Zambia

The historical changing climate pattern breakdown in Zambia suggests that rural households correctly perceive environmental change. Where the two sources diverge, more research is needed to understand whether rural households' perceptions are incorrect (with implications for their readiness to adapt to changing climate patterns), or whether meteorological records are inadequate for detecting some aspects of changing climate patterns. However, while other papers refer only to rainfall records, which basically focuses on the onset and offset of rains in the region to determine the kind of crops that can be cultivated over short periods in accordance with the rain periods.

Sikanwe (2014) states that climate change is real as it affect more than just a change in the weather, and it refers to seasonal changes over a long period. These climate patterns play a fundamental role in shaping natural ecosystems, and the human economies and cultures that rely on them. The average global surface temperature has warmed 0.8^oC in the past century and 0.6^oC in the past three decades (Hansen *et al.*, 2006), in large part because of human activities (IPCC, 2001).

In reference to Mwanaumo, (1999) in Zambia, any change in climate can spell disaster as a majority of citizens depend on agriculture, even a slight change in temperature can affect crops like maize with catastrophic effects for livelihoods and wildlife. In the villages of the southern province of Zambia (where this research was conducted), the returns from farming had diminished due to severe droughts. According to him, "rainfall is insufficient to give us a good crop yield" and "wild animals (elephants) often wander in the fields", further destroying crops. Elephant is a species of enormous economic value. If the elephant is properly managed to meet the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) conditions, Zambia can profit economically from the species through consumptive utilisation by way of trophy hunting, sale of ivory and other elephant by-products. Resumption of consumptive exploitation would add to the current benefits accruing from photographic safaris and the newly introduced elephant back ride safaris.

Sianungu, (2015) holds that concerning the species' role in the ecosystem, elephant plays an important function in the ecology of the habitats. Their feeding habits of breaking woody vegetation, opening up forest canopy and thickets, adapt the habitat. Pathways are created which other animals and humans alike can use. Elephants also facilitate seed

dispersal. Seeds of species such as *Faidhebiaalbida* are known to germinate from elephant dung. Several other woody plants benefit in the same way. Elephants also dig for water in dry riverbeds making water available to other species. Total elimination or loss of this keystone species would have a significant impact on the ecology of its habitat and other species. Elephants as a valuable renewable resource if managed properly would provide opportunities for income generation (Mudzonga and Chigwada, *et al.*, 2009). It is consequently, Government's intention to utilize this resource on a sustainable basis in non-consumptive ways as one of the most important tourist attractions and when conditions permit to resume consumptive utilisation through trophy hunting within an ecological framework, which seeks to set and balance between present habitat, species diversity and elephant population, changes in rainfall amount and pattern, as well as resulting flood or wildfire impacts African elephants. Drought directly affects the freshwater supply and plants which African elephants eat. Normally these animals move away from drought-stricken areas as long as they have space and access.

2.8 Changing climate patterns in Zambia

The success of past and current sustainable development initiatives in Zambia as they rise to meet the climate challenge as most, if not all, such interventions support attempts to stem the unrelenting impact of climate change on the elephant's population as a whole. These climatic scenarios which Zambia has been experiencing represent significant departures from average state of the climate system (Kanyanga, 2008). These climatic hazards are associated with human-induced climate change and natural climate variability. The climatic pointers have shown that the country has experienced an increase in temperature and a decrease in rainfall over the past decades. Research has established that over the past three decades, temperature has been increasing at 0.60C per decade. There has also been an increase in the incidence of extreme events along with their intensity and magnitude. The most serious ones have been drought, seasonal floods and flush floods, chronic temperatures and dry spells (MTENR, 2007).

Table 1: Table: Selected Impacts of climate variability in Zambia (1972 - 2008)

SEAS ON	SELECTED SOCIO-ECONOMIC AND ENVIRONMENTAL IMPACTS
1972/73	Poorest rainy season in 50 years; drought caused substantial drop in crop yields and a reduction in groundwater reservoirs
1977/78	Heavy rainfall resulting in urban flooding in Lusaka (Kanyama disaster –extensive infrastructure and settlement damages). This resulted in considerable damage to agricultural crops in many parts of the country.
1978/79	A drought rainy season, reducing maize production by 25 – 40 percent
1979/80	A poor rainfall distributed rainy season with elongated dry spells. This caused considerable losses to the 1980 maize crop in Southern Province.
1981/82	Below normal rainfall caused reductions in crop production as well as livestock production. Rainfall deficits ranged

	from 30 to 50 % in Southern & Western and 10 to 40 % elsewhere. The Luano Valley in Central Province experienced significant famine.
1982/83	Frequent dry spells during the season led to poor performance in the agricultural sector, especially over the southern half of Zambia
1983/84	Drought reduced agricultural yields for the third consecutive season; worst affected areas were Southern, Central and Western Provinces
1986/87	Frequent dry spells between February and March led to widespread crop failure in Southern Province
1988/89	Heavy rains in mid-season caused extensive water logging in crop fields; around Lusaka many people whose houses collapsed were left homeless and lost other household property.
1989/90	Persistent dry spell caused severe moisture stress in the major maize growing areas of Southern, Central and Eastern Provinces.
1990/91	Southern, Central and Lusaka Provinces experienced dry weather conditions. Marketed maize was only 46 % of annual requirement.
1991/92	Worst drought for many years hits the most critical crop stage (silk formation). All areas were declared disaster areas by the then Republican President, F.T.J. Chiluba.
1999/2000	Heavy rainfall caused floods in many parts of the country. (Season of "Mozambique" Floods).
2005/06	Heavy rainfall resulted in flash floods especially in the lower Zambezi (Kazungula floods, Kafue Gorge mudslide resulting in country wide ZESCO black out).
2007/08	Excessive rains over much of the country resulting in flash floods.

Source: Adapted from Kanyanga (2008).

The climatic patterns expounded in these studies are indicative of the effects of changing climate patterns. The effects have unpleasantly and massively affected on the Zambian population at all levels and virtually on all sectors of the economy, including on the natural and the built environment. Conspicuously, all the sectors of the economy are vulnerable to changing climate patterns with the most affected being agriculture, water, wildlife, forestry, health and energy. As pointed out by (ZVAC, 2008), food and water security, water quality, energy and the sustainable livelihoods of rural communities are some of the areas that have been adversely affected and this has consequently threatened the accessibility of vulnerable Zambians to adequate food, good health, safe and adequate water supply and sanitation and sustainable livelihoods in general. The evident effect of droughts and floods led to a significant decrease in the productivity of primary sectors like agriculture, fisheries, wildlife and tourism (MTENR, 2007).

2.9 Anticipated future changing climate patterns

Projections show that changing climate patterns are likely to continue into the future, meaning that the nature of changing climate patterns intensify, with the resultant changes for agricultural productivity, and therefore potential effects on security of food. The IPCC AR4 says that there is high consensus and much evidence that with current climate change 'mitigation' policies and related sustainable development practices, global greenhouse gas emissions continue to grow over the next few decades.

III. THEORETICAL AND CONCEPTUAL FRAMEWORKS

3.1 Introduction

This chapter presents theoretical Framework, Critical Review of Theory/Gaps in Theory (Criticism of Theory), Conceptual Framework Operationalisation of Concepts and Summary of the chapter.

3.2 Theoretical Framework of the Study

This section starts the theory which was adopted in this study, state what it is and also explain how it is related to the study or rather how it is applied in the context of the current study.

Before discussing theoretical framework, which was adopted in the study, it is essential to state what is meant by a theory because theoretical framework originates from a theory. A theory has been defined differently by different academics in different scholarly disciplines. Moore's theory is "*a reduction of our knowledge to basic ideas, presented in a way that shows their underlying patterns and relationships*". He also posits that "*a theory may refer to a set of concepts and principles about a phenomenon*" (2001, p. 2). Usually, a theory has a purpose of explaining or predicting the phenomenon under scrutiny.

3.3 Theoretical Framework explained

Creswell's theoretical framework is a collection of interrelated concepts, like a theory but not necessarily so well worked-out. A theoretical framework guides your research, determining what things you measure, and what statistical relationships you look for (Ivankova, and Creswell, 2009).

Theoretical frameworks are perceptibly critical in deductive, theory-testing sorts of studies. In those types of studies, theoretical framework must be very specific and well-thought out. Startlingly, theoretical frameworks are also important in exploratory studies, where you really don't know much about what is going on, and are trying to learn more. There are two reasons why theoretical frameworks are important here. First, no matter how little you think you know about a topic, and how unbiased you think you are, it is impossible for a human being not to have preconceived notions, even if they are of a very general nature. For example, some people fundamentally believe that people are basically lazy and treacherous, and you have kept your wits about you to avoid being conned. These fundamental beliefs about human nature affect how you look things when doing personnel research. In this sense, you are always being guided by a theoretical framework, but you don't know it (Bryman, 2001).

The framework tends to guide what you notice in an organization, and what you don't notice. We can never completely get around this problem, but we can reduce the problem considerably by simply making our implicit framework explicit. Once it is explicit, we can deliberately consider other frameworks, and try to see the organizational situation through different lenses.

3.4 The food systems approach

This study adopted 'food systems approach' as theoretical framework. In spite of having its roots in sociology and political science, food systems approach is a multidisciplinary concept which transcends several fields of scholarship and practice and as a social science concept it emerged to prominence recently in the 1980s and 1990s (Swaroop, *et al.*, 2012; Zheng and Thorne, 2012). A system as a set of components and relationships between them, functioning to act as a whole, has been detectable in science and in thinking about landforms for more than a century. For geomorphology, it was formalized in 1962 when the benefits of an open systems approach were articulated. The approach has become integral to many aspects of landform science, has been accompanied by other conceptual developments, and has been succeeded by self-organizing systems with non-linear relationships and more uncertainty.

Various Theories have been used in social sciences to explain the issue of the security of food. Nevertheless, to explain the link between changing climate patterns and the security of food, this study used the Food Systems Approach. This approach is borrowed from the systems approach which is grounded on the foundation that the security of food is a multifaceted issue linked in a multifaceted system composed of socio-cultural, soil characteristics, rainfall, agronomic practices and economic characteristics of the farmer and institutional arrangements (Wambua, 2008). The approach consequently offers explanation regarding how agricultural production is determined by the interrelationship between different components such as socio-economic, biophysical and political attributes (Singh 1987; Andrew 1997).

The food systems approach is grounded on food systems, which allude to a set of activities comprised producing, processing and packaging, distributing, retailing and consuming food (Brown. *et al.*, 2015). Consequently, this approach systematically describes all of the activities, processes and outcomes involved in modern food systems and all possible connections with global changing climate patterns. In other words, the approach illuminates the relations between and within the bio-geophysical and human environments which define how food system activities are carried out.

3.5 Critical Review of Theory

3.5.1 Relation of food systems approach to the Current research

The food systems approach helps us organise our thinking about how the different food system players can come together to progress food security and health outcomes at a reduced natural resource and environmental cost. As discussed in the previous section, complex systems thinking emphasizes not just on a single aspect or subject, but on how all the elements of a system come together and interrelate with each other. The food on our plates is the

product of numerous activities, relationships and processes that make up a food system - and we, as consumers, are part of the system, too. But to be sustainable, food systems do not just need to keep people well nurtured; they also have to use natural resources in a way that will not diminish or destroy them. Food systems today have numerous negative environmental impacts.

The conceptualisation of food systems has important implications for how wide to cast the net when trying to determine the vulnerability of those food systems to stresses such as changing climate patterns. Much work has been undertaken to address then agronomic aspects of changing climate patterns, looking at how changing climate patterns may affect crop productivity. Whilst this is important, other research questions have been raised as being important in linking this agronomic research to a wider appreciation of the effect of changing climate patterns on food systems. These include: an understanding of how changing climate patterns affect cropping systems; assessing technical and policy options for either reducing the deleterious impacts or enhancing the benefits of changing climate patterns on cropping systems while minimising further environmental degradation; and understanding how to best report and communicate agronomic research results that assist the development of food systems adapted to changing climate patterns (Ingram, Gregory, and Izac, 2008).

3.5.2 Entitlement theory

This thesis reviews two major approaches to food security: food security analysis and entitlement theory. Food security analysis is based on the premise that food security is based on a system approach whereby four dimensions are important: availability, stability, utilisation and access to food. Climate change is likely to impact on all four of these elements, not just on availability. Amartya Sen's entitlement theory is based on the notion that food can be available through means other than direct in-country production, and thus food security is dependent on entitlements, which can be related to production, labour, trade or transfers.

3.5.3 Theory of Change

Theory of Change has ascended to importance provoked by disappointing results from previous the security of food interferences, and a growing trend in results- and impact-orientation for development investments. The submission of Theory of Change has reached a watershed in international development. This requires remarkable capacity-building to facilitate its appropriate introduction, adoption and adaptation for use, not only as an accountability tool, but also as a tool for critical thinking and reflection on the ways a project can achieve a 'pathway to impact'. The introduction of Theory of Change and impact pathways in research for progress is shifting the conventional evaluation focus, from the relations between inputs and outputs to the relations between outcomes and final impacts. This ending step is hard to institute and forecast, because every project exists in an inherently complex

system. It is referred to as the 'attribution gap' or the 'missing middle'.

The 'missing middle' presents a significant challenge in agriculture research for development, because conventionally projects generally finish with outputs that can then be adopted through local extension services. While research and development interventions often have lofty neither the security of food and poverty reduction goals, the underpinning assumptions about how and why the interventions work to achieve the goals beyond outputs are often not explicitly articulated, nor the underlying assumptions discussed. These challenges are evident from the literature reviewed as part of Inquiry. These were confirmed through interviews with 25 thought leaders engaged in international research and development programs in Africa and Asia. These interviews also revealed that understanding of the use of Theory of Change, and the capacity to use it effectively, is poorly developed in international agriculture for development. In addition, tools from systems thinking and practice are needed to assist project and program managers in making decisions about when it is appropriate to use Theory of Change and impact pathways, and when more traditional planning and monitoring and evaluation tools suffice.

3.5.4 Critical review of Gaps in Theory

3.5.4.1 Criticism of theory of Change

Substantial conceptual and practical developments have developed in recent years on the way research is used to drive innovation in food systems. These present possible new avenues for addressing the security of food. The objectives of this analysis were to evaluate the effects of environmental factors on food security in Monze district and assess compatibility issues related to improved crop varieties and local community perceptions in uptake to grow, consume and increase the marketability of new products.

The intricacy of the security of food and ways of tackling it has led to uncertainty and contestation about how best to proceed. Nevertheless, there are potentially useful synergies between different concepts used to comprehend food insecurity which have not been fully discovered. Tools like Theory of Change have emerged as a way of tackling this, but these are poorly understood in practice, and necessitate further improvement and a stronger systems-orientation in application.

Working with Theory of Change should nurture systems thinking. There are variances in the type of difficulties and dimensions of the security of food in different contexts that interventions address. This requires a study on typology of problems-based Theory of Change. An instantaneous insinuation of this is that a wider palette of social science expertise be needed in the security of food research and development interventions. The analysis of the current research and practice on Theory of Change implies that further efforts are required to capitalise on this approach.

3.5.5 Criticism of the food systems approach theory

It is important to note that this approach is focused on global and national food security and does not consider the aspect of food security at the household level. In view of this, this study examined how the approach relates to household level food security in rural areas and the inter-linkages are demonstrated in figure 1, which provides the conceptual framework for the study.

When applying this framework to Zambia domino effect show that the combination of global and national economic changes is shifting the context under which farmers cope with changing climate patterns and adapt to long term change. Those farmers that “win” from both changing climate patterns and economic liberalization are the rural commercial farmers, whilst those that “lose” from both processes are the smaller, poorer farmers (Leichenko and O'Brien, 2002). Recognizing the appropriate winners and losers from the interaction of global processes has imperative implications for policies to address vulnerability (O'Brien and Leichenko, 2003).

The main underlying focus of the double exposure concept, and multiple stresses framework, is that the interaction of the various acting processes can only be examined in specific contexts. Much on-the ground empirical research has taken place in Zambia to look at the nature of vulnerability to climatic stresses on the rural households. In Choma district, Zambia (which about a 100kms away from Monze district, our study site), for example, investigation has taken place into how rural communities adapt to the stresses of water, climate and health (Sianungu, 2015).

The food systems approach theory is theoretically flawed and could not accurately identify variables that influence food availability of rural community and identify compatibility issues related to improved crop varieties and local community perceptions in uptake to grow consume and increase the marketability of new products. Philosophical ideas have a remarkable effect on the practice of research. It is for the reason that the following section grants attention to what is meant by the ‘philosophical worldview of the study’. The section also names the constructivist worldview as the adopted philosophical worldview for the current study.

3.6 Conceptual Framework

A conceptual framework can be described as an analytical tool with several distinctions and contexts. It is used to make conceptual distinctions and organize ideas. Strong conceptual frameworks capture something real and do this in a way that is easy to remember and apply (Ravitch and Riggan, 2012).

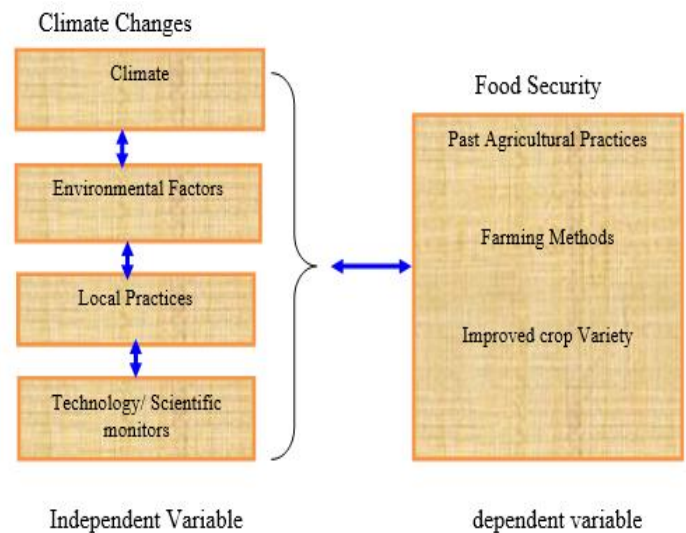
Conceptual frameworks are mainly valuable as organizing devices in empirical research. One set of scholars has applied the impression of conceptual framework to deductive, empirical research at the micro- or individual study level. Shields and Rangarajan (2013) argue that likewise, conceptual frameworks are abstract representations, connected

to the research project's goal that directs the collection and analysis of data (on the plane of observation – the ground).

The framework differentiated between environmental and climatic factors which assimilate together to influence food availability of rural community. Climate-related factors such as droughts and floods influence food availability of rural community in various ways such as constraints on quality of soil and prompting crops and animal diseases (Scoones *et al.*, 1996). The non-climatic stresses on the other hand include land fragmentation due to population growth, market failures, and prevalence of diseases affecting the health of farmers (Morton, 2007). However, as indicated in Fig. 1, unlike Morton's initially suggested framework, another impact propeller “institutional constraints” (such as public, private, and civil society support) was introduced.

Diagrammatically conceptual frame work has been presented as follows:

Figure 1: Conceptual framework for climate change impacts on smallholder farmers



Source: Author's conceptualisation

3.5.6 Summary

Discussed under the study's ‘theoretical framework’ was the collection of interrelated concepts of the study. Theoretical framework (food systems approach theory) as well as the research methods (Interviews, weight measuring of Infants (U5s) and Focus-group interviews/ discussions) employed in the study. This section stated theory which was adopted in this study, stated what it is and also explained how it is related to the study or rather how it is applied in the context of the current study.

IV. RESEARCH DESIGN AND METHODOLOGY

4.1 Introduction

This chapter advances what was done in the previous three chapters as it focuses on the ‘research design’ and

methodology, considers the research philosophy and design strategies underpinning the said study. It covers some of the frequently used philosophical assumptions and discussed out of which an appropriate assumption for this study was identified. The chapter also discusses research strategies used in the study, sources and type of data collection and analysis.

4.2 Nature of Research and Research Paradigm

The desire for knowledge and understanding using scientific procedures is what Kothari & Garg (2014) and Pandey & Pandey (2015) call research. Kumar (2011) describes research as a process where data collection and interpretation is systematic and the purpose for the research is clearly known. However, the option of the research method is dictated by the research philosophy and research paradigm. Every research is founded on some underlying assumptions which dictate the type of research method to be applied. Saunders *et al.*, (2009) emphasises the need for clarity on the type of philosophy, approach, methodology, strategies, techniques and procedures for research to be successful. The research philosophy can either be positivist, realist, interpretivist or pragmatist. Events are understood through the mental processes of interpretation that is influenced by interaction with social contexts.

This study applied the interpretivist philosophy because in this approach the researcher does not stand above or outside, but is a participant observer (Carr and Kemmis, 1986, p. 88) who engages in the activities and discerns the meanings of actions as they are expressed within specific social contexts. Moreover, those active in the research process socially construct knowledge by experiencing the real life or natural settings. In this regard, the researcher who is the Inquirer and the inquired (research participants) become interlocked in an interactive process of talking and listening, reading and writing. This becomes more personal and quite interactive mode of data collection. Therefore, this study had to rely on the interpretivism philosophy as it allows participation, collaboration and engagement (Henning, van Rensburg, and Smit, 2004), in attempting to understand the phenomena from an individual's researcher's perspective.

Research paradigms are basic beliefs about the worldview for collecting and interpreting data (Guba & Lincoln 1994; Grbich, 2013; Wilson, 2001). This worldview is about the characteristics of the world and the role an individual play in this world. Paradigms inform the philosophy of research. Each one of them has certain characteristics which attract the researcher once they realise they can identify with it. It is worth noting that paradigms have no levels or classes and so none are better than the other (Terre Blanche & Durkheim, 2006). All is dependent on the type of research. Paradigms consist of an ontology, epistemology, and methodology. This research adopted the subjective ontological approach because of the nature of the inquiry. As for the epistemological approach, the research used the interpretivism-constructivism approach.

4.3 Research Design

Research design is the general plan of how one goes about answering the research questions (Creswell, 2003), while Maree defines research design as a plan or strategy which moves from the underlying philosophical assumptions to specifying the selection of respondents, the data gathering techniques to be used and the data analysis to be done (Maree, 2007). Meanwhile Mouton (2006) contended that research design as a plan or blueprint of how one intends to conduct the research. Therefore, this research was regarded as an arrangement of conditions for collection and analysing of data in a manner that aimed at combining relevance with the research purpose (Kombo and Tromp, 2006; Orodho, 2003 and Kothari, 2011).

The study used a descriptive research design involving both quantitative and qualitative data i.e. questionnaire for quantitative and Focus Group Discussions (FDGs) for qualitative. Descriptive research is defined as a research method that describes the characteristics of the population or phenomenon that is being studied. This methodology focused more on what's of the research subject rather than the why's of the research subject. Bryman and Bell (2003) and Creswell (2003) describe descriptive research as primarily focusing on describing the nature of a demographic segment, without focusing on why a certain phenomenon occurs. In other words, it describes the subject of the research, without covering why it happens.

The data collection for descriptive research presents a number of advantages since the data collected is both qualitative and quantitative; giving a holistic understanding of a research topic. Since the researcher relied on both QUA + qual (Qualitative and quantitative) research, the researcher opted to conduct the study that focuses on six strata (sites) i.e. Mwanza, Moonze, Ufwenuka, Hamusonde, Choongo, and Chona instead of one site only (Schumacher & McMillan, 1989). The research believes that by conducting a study across geographical locations makes the study systematic as the study shall make an inquiry into an event or a set of related events which aims to describe and explain the phenomenon of interest [in this case an assessment of the effects of changing climate patterns on food security (Bromley, 1990), within Monze district of Zambia.

This design was adopted because it offers the basis for understanding the experiences of the rural households with regard to food security in the context of changing climate pattern. In addition, the design also helped in understanding aspects of the study such as the effects of environmental factors on food security in rural households of Monze district as well as investigating effects of local knowledge practices on food security within the district. It was also preferred because it gave the researcher the freedom and flexibility in terms of research methods in case there was need to change especially if some challenges related to data collection came up.

4.4 Target Population

Saunders *et al.*, (2012), defines a target population as a representation of a specific segment within a wider population that is best positioned to serve as a primary data source for the research. Monze district has a total population of 191,872, according to the Central Statistical Office (CSO) 2010 Census of Population and Housing Population Summary Report (June 2012). This represents 12.1 percent of the total population of Southern Province (1,589,926) and 1.4 percent of the total population of Zambia. However, the research was targeting the emerging and small-scale farmers who are engaged in Self-Help Group activities within Monze district who were being sponsored by Health Education Programs – Zambia.

Msabila & Nalaila defines population as an “a complete set of elements that possess some common characteristic defined by the sampling criteria established by the researcher” (Msabila & Nalaila, 2013, p. 36). The elements of a population can be either persons or objects. The individuals or objects of a population ought to always have a mutual characteristic or trait. It is for the reason that of this aspect that a research population is also defined as “a well-defined collection of individuals or objects known to have similar characteristics. All researches identify 'research sample' which will provide all the information necessary for answering the research questions as it was impractical for research to engage everyone in the study population. A population refers to all elements that satisfy the sample criteria for inclusion in the study. A sample is “a proportion of a population” (Polit *et al.*, 2001). This study population consisted of 75 emerging and small-scale farmers and 25 key informants (Ministry of Agriculture staff, traditional leadership) within the district of Monze in Southern Province of Zambia. The respondents constituted emerging and small-scale farmers within the 6 chiefdoms of Monze district. The sample size consisted of 75 emerging and small-scale farmers and 25 traditional leadership and Staff from Ministry of Agriculture, Ministry of Lands, and Ministry of Green Economy. The choice for this sample size was mainly based on the need for accuracy required by the researcher and the degree of variation in the sample (Babbie, 1990). Strydom and Venter (1996) describe sampling as the process of taking a portion of a population as a representative of that population. The process of sampling is necessary due to large size of a population and the consequent impracticality and prohibitive cost of testing each member of any population (Denzin, 2000).

In every given research work, the researcher is indebted to choose individuals to form the sample of the study. It is attributable to this fact that the next section discusses the important research aspect of ‘sampling and sample size’. The sample size was a 100 obtained by using the equation below.

4.5 Description of the Sample and Sampling Procedure

The study had a sample size of one hundred rural households. In addition to the rural households, the study picked on ten key informants. The one hundred households were determined

using Nasuirma (2000) model of determining the sample size, while the key informants were selected purposively. The Nasuirma model asserts that a sample size (n) can be determined by the equation:

$$n = \{NC_v^2\} / \{C_v^2 + (N-1) e^2\} \quad (1)$$

Where: N = is the target population

C_v = is coefficient of variation

e = desired level of confidence

For this study:

N = 165,741 (this was the estimated number of rural households for the whole district)

C_v = 0.5

e = 0.05.

Therefore: $n = \{NC_v^2\} / \{C_v^2 + (N-1) e^2\}$

$$165,741 (0.5^2) / 0.5^2 + (165,741-1) 0.05^2$$

191,872,

5839/58.3775

100.02

n = 100 households

The researcher employed purposive sampling in this study. It was supposed to comprise only people with extensive experience and expertise with changing climate patterns and its effects on the security of food in rural households of Monze district.

However, due to the Covid-19 pandemic which requires that the health protocols (of sanitising, masking, keeping at least a distance away from each other, avoiding crowded places and preferring staying at home). To support this tool, the researcher measured the weights of all the children found in each household which was interviewed as long as the baby was under 5 years old. This was as a result of the researcher assuming that out of the breast milk, the nutrients to the baby do come from the intake of food nutrients from the mother.

4.6 Sampling procedure

4.6.1 Sampling and Sample Size

Sampling is the process of choosing a number of individuals or objects from a population such that the selected group comprises features representative of the characteristics of the entire group (Kombo and Tromp, 2006; Best and Kahn, 2008). Through sampling a researcher can choose the characteristics of a sample and from it, infer the characteristics of the larger population from which it was derived. Sampling is observed from a slightly different perspective by Rwegoshora (2006, p.109).

The main purpose of sampling is not the type of units or persons to be observed or interviewed but how many units of

what particular description and by what method they should be chosen. There are various categories of sampling namely: probability sampling and non-probability sampling. Agreeing to Sidhu (2006, p. 31), “under probability sampling is simple random sampling and under non-probability sampling are sampling techniques such as snowball sampling and purposive sampling”. In purposive sampling a group is nominated by the researcher from a population to constitute a sample and such a group is nominated on grounds that it possesses characteristics representative of the entire group from which it was nominated (Sidhu, 2006; Rwegoshora, 2006; Kombo & Tromp, 2006). In other words, in purposive sampling, the researcher purposively chooses as well as purposively leaves out members of a group.

The researcher heavily relied on purposive sampling because the sample selected was on the basis of the researcher’s own experience (Mason, 2002; Patton, 2002). It comprised only people with broad experience and expertise with changing climate patterns and its effects on the security of food in rural households of Monze district of Zambia. The sample included emerging and small-scale farmers (men and women) drawn from all the six chiefdoms. Questionnaires were administered to key informants (i.e. Ministry of Agriculture, Ministry of Lands, Ministry of Green Economy, traditional leaders) who had first-hand information or knowledge on the topic. This was because the researcher considered the participants well versed to provide the solutions to the research problem.

The researcher operated within the sites (Monze district) with two different NGOs before; hence, the researcher was able to purposely select the participants in the research (Babbie, 2001). A purposive sampling procedure was used for the purpose of drawing a representative sample, from whose findings generalizations to the bigger population are made. Advantages of purposive sampling are that people who do not fit the requirements are eliminated and it is less expensive as it involves lesser research costs. A limitation of purposive sampling is that, it is the responsibility of the researcher to choose participants, there is a possibility that the researcher could be wrong in choosing suitable participants for the study (Gillham, 2000). The researcher took care of this limitation by stratifying the sample so that the research can have rich data obtained from the six (6) different strata (chiefdoms). The unit of analysis for this study was the Chiefs and the village headmen who were members of the Savings Loans Associations (SLAs), as the researcher came up with rich and comprehensive understandings about the population (Bromley, 1991; Creswell, 1997; 1994; Stake, 1978, Yin, 1984) of Monze district in Southern Province of Zambia.

4.6.2 Sampling procedure

In the selection of the sample the study employed a multi – stage sampling. This is carried by first doing a cluster sampling which comprised dividing the study area into geographical units (chiefdoms) for purposes for easy coverage.

4.6.3 The study Location

The study was carried out in Monze District, Southern Province of Zambia. Monze is in the Southern Province of Zambia, located 120 miles south of the capital Lusaka on the Great North Road, and is on the route to Livingstone and Victoria Falls. The population of Monze District is in the order of 800,000. However, the town itself which includes shanty town expansion and traditional village communities within 30-40 minutes’ walk of the town centre is about 15,000. Monze is surrounded by small communities often referred to as compounds. The plan to the right is not a literal reproduction of Monze's layout, but does give an indication of relative positions of key buildings. Monze is approximately 3,700 feet above sea level and its climate is temperate. Snow ball sampling was used to select the study participants as one of the few districts which was well known as the “Maize belt” of Zambia and besides that, the researcher has undertaken a lot of developmental work in the province and has quite some experiences in climate change and food security.

4.7 Description of Research Instruments

Research instruments are tools which the researcher has to select bearing in mind that it has to measure the concepts relevant to the research question since research is constructed through rigorous, systematic inquiry. Therefore, research tools are used to collect and structure data thus transforming it into useful information. These include; Questionnaires, Interviews, Content analysis, Focus Groups, Observation, Researching the things people say and do. However, in this research, the researcher concentrated on Questionnaires, Focus Groups Discussions and the weighing of the under children (Hinds, 2002; Zohrabi, 2013; Switzer, *et al.*, 1999).

4.7.1 Research Instrument: Questionnaires

Questionnaires are doubtless one of the primary sources of obtaining data in any research endeavour. However, the critical point is that when designing a questionnaire, the researcher should ensure that it is “valid, reliable and unambiguous” (Richards & Schmidt, 2002, p. 438). On the whole, questionnaires can appear in three types: 1- closed-ended (or structured) questionnaires 2- open-ended (or unstructured) questionnaires 3- a mixture of closed-ended and open-ended questionnaires. As a matter of fact, closed-ended questionnaires provide the inquirer with quantitative or numerical data and open-ended questionnaires with qualitative or text information. In this regard, Blaxter *et al.* (2006, p. 170) divide questionnaires into “seven basic question types: quantity or information, category, list or multiple choice, scale, ranking, complex grid or table, and open-ended.” On the other hand, mixed method approaches usually use closed-ended questionnaires (numerical data), interviews and classroom observations (text data) to collect information (Seliger & Shohamy, 1989; Robinson, 1991; Lynch, 1996; Nunan, 1999; Gillham, 2000; Brown, 2001).

4.7.2 Research Instrument: Focus Group Discussions (FGDs)

These are a specific type of qualitative interview technique typically conducted on group basis on selected topics of the research (Kvale, 1996; Administrative Methods, 2010). In his definition of a 'focus group interview', Bryman (2008, p. 47) focuses on the uniqueness of such interviews when he argues that, "they typically emphasize a specific topic or theme that is explored in depth according to the investigators preferences". Usually, "focus group discussions consist of 8-12 pre-vetted members and last between One (1) to two (2) hours" (Administration Methods, 2010, p.1) but their sizes and duration usually differs depending on the researcher's preferences. The use of FGD has its own advantages to the research process. The next section focuses on the rationale for using focus group discussions in this research (Newby, 2010).

4.7.3 Research Instrument: Weighing of Under 5 (five) children

A weighing sling (spring balance), also called the 'Salter Scale' is used for measuring the weight of children under two years old, to the nearest 0.1 kg. In adults and children over two years a beam balance is used and the measurement is also to the nearest 0.1 kg. In both cases a digital electronic scale can be used if available. This has to be re-adjusted the scale to zero before each weighing whilst checking whether the scale is measuring correctly by weighing an object of known weight. The researcher improvised to use this approach whilst in the field.

4.8 Description of the Data Collection Procedures

This basically refers to the process followed by the researcher to obtain permission, informed consent and assent from the research participants. The researcher obtained permission from the target institutions and assent from selected farmers for the focus group interviews/discussions.

4.9 Description of Data Analysis and Presentation Procedures

4.9.1 Data analysis

The project used sequential mixed methods as primary research designs to collect and analyse data (QUAL -quan). Sequential mixed methods is one of the research designs which involves explanatory, hence, it was appropriate to use as it is highly popular among researchers and implies collecting and analysing first quantitative and then qualitative data in two consecutive phases within one study (Tashakkori and Teddlie 1998; Creswell 2003, Ivankova, et al. 2006; Creswell et al. 2003), and this design has been found application in both social and behavioural sciences research (Kinnick and Kempner 1988; Klassen and Burnaby 1993).

Even if sequential mixed methods is said to be highly popular, this design is not easy to implement as a researcher who chose to conduct a mixed methods sequential explanatory study did consider certain methodological issues which included the

priority or weight given to the quantitative and qualitative data collection, the sequence of the data collection and analysis, and the stage/stages in the research process at which the quantitative and qualitative phases are connected and the results are integrated (Morgan 1998; Creswell et al., 2003; Ivankova, et al., 2006).

This process involves collecting quantitative and qualitative data before analysis is conducted in sequence or concurrently (Creswell 1999; Green and Caracelli 1997; Green et al., 1989; Morgan 1998; Creswell et al., 2003; Tashakkori & Creswell 2007).

4.10 Ethical Considerations

Research ethics refer to a code of behaviour, moral principles and values which are expected of the researcher (Berg, 2004; Creswell, 2014; Hammersley and Traianou, 2012; Muswazi and Kanhukamwe, 2003; Ghauri *et al.*, 2020; Neumann, 2014 and Shawl *et al.*, 2011). Ethics are concerned with extent to which researcher is ethically and morally responsible to his or her participants. The researcher adhered to research ethical considerations in conducting the study by applying research ethics on all stages of the research namely planning, and conducting and reporting the study. The researcher did not use deception on people participating instead she made use of an introductory letter in conducting interviews, questionnaire and focused group discussions to gain the research participants' informed consent.

4.11 Summary

The purpose of this chapter was to present a discussion of the research philosophy and research design for the study, mostly regarding the data collection method, its population and sampling frame, questionnaire development, the sampling process, research quality and analysis. The succeeding chapter presents research results based on questionnaires and interviews responses.

V. RESULTS AND DATA ANALYSIS

5.1 Introduction

This chapter presents results of the questionnaire, the focus Group discussions and the weights measured of babies under 5 years old. The findings focused on addressing the four major objectives: (1) *To determine effects of local knowledge practices on food security in Monze district*, (2) *To extrapolate the effects of scientific monitors (technology) on food security in Monze district*, (3) *To identify strategies that rural households in Monze district use to mitigate potential effects of changing climate pattern on food security*, (4) *To assess compatibility issues related to improved crop varieties and local community perceptions in uptake to grow, consume and increase the marketability of new products*.

5.2 Socio-demographic Characteristics of Participants

The demographics of the participants allude to the statistics relating to the research respondents who took part in this

study (Babbie, 2007). Therefore, this study had a total of 75 participants. Majority (56%) of the participants were female and were either a widow / widower (39%). Most (42.7%) of the participants had attained tertiary level of education and did not have an under-five child (69.3%). Furthermore, the study revealed that 7 in 10 of households' source of livelihood was mixed farming. It further showed that most households had fewer adults (54.7%) compared to children (60.0%). There are 30% of households with children who are under 5 years old who were targeted for measuring the weights.

5.3 Food Consumptions Patterns and Food Security

5.3.1 Food Consumption Patterns

This study sought to determine the frequently consumed foods at household level in the past month. The results revealed that food eaten was often not enough for most households (70.7%), all households run out of food at some point (100%) and all households experienced hunger but could not eat due inadequate food (100%). Additionally, the study findings indicate that majority of adults (68%) and children (53.3%) went hungry. Besides close to all households (97.3) reported cutting meals due to inadequate food. The study also found that the most consumed food products in the past month included beans (100%) and Irish potato (100%).

5.3.2 Food Security

Food security was determined using the household hunger score arrived at by combining 5 variables meant to measure hunger at household level. The variables used in determining food security included food eaten, hunger, running out of food, adult slept hungry, child slept hungry, cut meal size due to inadequate food. After combining the two, we categorized the variable into two categories with one representing high levels of hunger (score > 6) and low level of hunger (score ≤ 6). Given these changes, the study indicated that about 29 (39%) of the participants showed a high level of hunger while the rest, about 46 (61%) did not.

5.3.3 Livestock Ownership, Water Source and Farming Characteristics

The study also obtained data on household livestock ownership, water source, adequacy of the water and strategies used to address any inadequacies. The study also assessed the prevailing farming characteristics at household level. Data obtained showed that all participants owned livestock and majority (68%) indicated that this number had decreased significantly overtime. Reasons that could be attributed to this decrease were mostly (81.3) decreased grazing land. It is also important to mention that over 70% (70.7%) of the households did not have cattle producing milk.

5.4 Factors Associated with Food Security

5.4.1 The Association between Socio-demographic Factors and Food Security

We performed either a chi-square test or Fisher's exact test to determine factors significantly associated with food security. The study revealed that level of education (p value < 0.001) and marital status (p value < 0.001) were the only factors associated significantly with food security.

5.4.2 Food Consumption Patterns and Food Security

The study found that having fewer meals (p < 0.001), worried about food (p < 0.001), maize consumption in the past month (p = 0.027), consumption of meat (p = 0.001) and vegetable consumption were significantly associated with food security.

Weather forecast information access by the respondents

The respondents were asked to explain whether they have access to weather forecast information for early warning purposes and from which source. Sixteen percent of the respondents from Bweengwa, 10% from Monze Central, and 22% Moomba did not have access to any form of weather forecast information. In total, 15% of the respondents did not have access to any weather forecast information. Drawing from the respondents' perceptions, it is clear that the study area is more vulnerable to dry spells, droughts and to some extent, violent storms. This group practiced farming with no knowledge of weather changes at all. When comparing the growth curve of an individual child one should pay much attention to the three (3) directions:

- 1) Up - wards direction (Good)
- 2) Flat (static) - danger sign
- 3) Downward direction (very dangerous)

The reference line shows only an upward movement. In the beginning (in the first year) the line is steeper than later. If the direction of the growth curve is downwards or flat, it means that the child is "At Risk".

The measurements were taken by the researcher in the company of a midwife in a standardised way, by using a standard salter scale. Weighing and reading using a salter scale. Hang the scale securely to a firm stand ensuring it was at eye level while ensuring that the hanging of the weighing bag was at the hook of the scale. The researcher did adjust the scale to zero before starting the weighing session, checking the accuracy of the scale using a known standard weight to avoid errors in weighing and plotting, ensuring that the child had minimum clothing before weighing. The researcher had removed the weighing pants from the scale before placing the child in the weighing pants. The researcher made sure that when reading, the dial was at eye level so that to ensure the weight reading was stable.

The above results exhibit the nutritional status of children who do not only reflect directly, the socioeconomic status of these rural households and social wellbeing of the community, but

also the efficiency of the health care system, and the influence of the surrounding environment. However, based on the results, it was evident that some of the households where these children were measured, it was noted that either the height for age was stunted, or weight for height was wasted or and weight for age was under weight. The researcher relied more on the weight for age which was under weight. There was gross negligence as in some cases; some of parents never took their children to the health facility for the Under 5 (five) clinics so that the growth weight may be measured. The children under 5 cards were blank indicating the missing months.

5.5 Validation with Agric Block Officers

The researcher did validate the data received from others sources through the Agriculture Block officers who are in charge of the research participants i.e. emerging and small-scale farmers within Monze district of Zambia. There are five (5) Agriculture Block Camps in Monze with a total of thirty-nine Agriculture Camps. Out of the five Agricultural Block Supervisors managing thirty-nine (39) agricultural camps, three are female. There are twenty-one (21) female and eighteen (18) male Camp extension officers who report to Block Supervisors. In validating this data from the emerging and small- scale farmers, the Agricultural Block Supervisors responded as follows:

a. *What are the local knowledge practices on food security in Monze district?*

Since time in memorial, mankind survived on food, whether cultivated in the fields or gathered from the wild. Believing that seasons change and moments of scarcity do occur, man has over time developed practical means of securing food for nutrition and survival. Monze is in agro-ecological region *IIB*, meaning it receives average rainfall between 500 to 700mm and in between can be serious droughts impairing food productivity resulting in food shortages. Therefore, some of the practices used for food security are as follows:

- Preserving some food stuffs through drying of fresh vegetables such as pumpkin and bean leaves, drying boiled sweet potatoes and drying local cucumbers. Meat and fresh fish are equally dried for preservation for use in time of need.
- Storing grain (Maize or sorghum) in locally made pole and mud granary sealed with a small outlet left at the bottom for discharging grain. The grain is mixed with layers of ash during storage while the mud is mixed with cow dung at plastering to prevent pests.
- Covering the harvested fresh sweet potato back into the trench with ash and soil.

Preserving the food stuffs through drying (Kwaampa) e.g. vegetables, boiled fresh maize or boiled sweet potatoes and fruits such as mangoes they are preserved through drying after

slicing them removing the seeds. Sweet potatoes are also preserved by digging holes and burying the staff for later use.

b. *What are the effects of scientific monitors (technology) on food security in Monze district?*

There are a number of effects that scientific monitors have on food security. These technologies range from food production to food preservation and post-harvest management. The following are some of the technologies:

5.6 Conservation farming methods:

The aim is the restoration and maintenance of land fertility through three principles namely:

- minimum tillage,
- retention of crop residue and
- crop rotation with a legume.

These are technologies developed in order to enhance timely and effective management of crops by farmers. Technologies such as ripping the soil open using the Magoye ox-drawn ripper will facilitate early planting of the crops such as maize, sorghum, cotton and many others. Land preparation is done within a short time; half the time it takes to plough a given unit area. These crops will optimize on the ideal growing period and produce yields to their full potential therefore enhancing food security and household incomes.

Planting in ridges with the residue removed over the seed allows the soil to dry and warm faster in the spring compared to the no-till system. This may be more important on the poorly drained soils where early no-till planting has been generally less successful. If conventional seedbed preparation is left till planting time, excessive spring rains can delay timely planting. The Herbicide usage may be reduced as well if chemicals are banded over the ridge and cultivations are relied upon to control weeds that emerge between the rows.

The responses from the emerging and small-scale farmers indicated that respondents had no choice as their choices of inputs were in the hands of the one provider. It is also possible that other than following the conventional ways of farming for mere inputs, these respondents embrace these practices for profit making.

Some of us what we know about local knowledge is that we have crops meant for men and crop for women like, most of the cover crops are meant for women and for men Cotton and sunflower. BB5, BB9, BB21, BB22

So far, we are taught to plant in ridges, contours, and across the slope to prevent soil erosion. Also, we plant trees to hold the soils together and prevent soil erosion. It has been easy to citrus fruits since we are able to see the benefits than any other tree. BB2, BB7, BB8, BB9, BB28, BB30

5.7 Post-harvest Technologies:

There are modern methods that are used both at emerging, small scale and large levels to preserve the harvest for future use. These include silos which have been constructed by government to store huge amounts of maize grain for food security in the province and the Nation. At farm level small modern granaries are constructed using cement. Pre-treated grain bags of various sizes are used for storage. Chemicals such as Actellic supper, Chirindamura and some fumigants are used in stored grain to prolong their shelf life and prevent pest damage. Preservatives are also being used in locally brewed sweet beer known as “Chibwantu” and are bottled for sale in public outlets. This allows the availability of the local drink at all times.

Use of preservative dugs like *quickphos* tablets to treat the maize and before the drug expires when that maize is consumed has side effects on the human lives, also on the part of preserving fresh milk which can later be used as sour milk becomes dangerous in the sense that some farmers prefer turning the milk into sour using the same container which might have accumulated some bacteria which can cause diseases like Tuberculosis.

Pre and Post-harvest losses control storing treated grain and legumes in 50kg bags, Use of Hermatic storage which are air tight to prevent and kill all the insects’ eggs from the field. Sweet potatoes store in pits. They use Conservation Agriculture practices i.e. minimum tillage, Crop Rotation, moisture retention by not burning Stover early land preparation is the key to early planting. Technology supports economic growth and social wellbeing, effective pre and postharvest practices to minimise losses of produce from field to homesteads, effective storage and conservation practices, increase value of harvested produce, identification of high value products.

Figure 2: Types of Granaries for food storage



Source: MoA, Camp Office, Ntambo Village in Monze East and it is supposed to appear like one on the right-hand side from Mt. Makulu Research Station, Chilanga.

For grain bins such as the ones above, can store almost 27 x 50kgs bags for period of 12 months from one Harvest to another year. The above bin with the rightful moisture content, can store legumes and grain from one farming season to another.

During post-harvest, emerging and small-scale farmers usually would make a grain barn such as the one above. However, after shelling the grain like maize, the grain kept in the sacks and sold or kept and some of them, emptied in the Grain Bins mentioned above. During the field visits, it was discovered that out of every ten (10) households (research participants), one (1) or two (2) at most households had a Grain Barn which were as empty as the one above in **Fig (2)** which is an exhibition of household food insecurity which the communities of Monze district have been facing for some time.

c. What are the strategies that rural households of Monze district use to help mitigate potential effects of changing climate pattern on food security?

Emerging and small-scale farmers have suffered huge losses on their crop and livestock as a result of climate change. The effects are devastating as they boarder on human life. The following are some of the mitigation measures farmers are undertaking:

i. Farming methods

For a long time, farmers have been using land preparation methods such as ploughing that have been harmful to the soil and the crop, resulting into poor yields. Therefore, Ripping and basin making (potholes) are the methods used in land preparations to mitigate climate change. However, the most popular between the two is ripping. This method is done just after crop harvest (dry season) and farrows are opened using a

ripper either drawn by oxen or tractor way before the onset of the rains. This enables farmers to plant their crops early with the first good rain and it allows the crop to draw sufficient moisture for growth throughout the season as this method stores enough moisture in the soil during dry spells.

ii. Diversification of Crops

Farmers no longer grow one crop on their farmsteads. The diversification into growing many different crops that mature at different times within the season have helped in mitigating change of climate.

iii. Mixed Farming

Most farmers are not only into crop production but are also rearing livestock such as cattle, goats, pigs, chicken and fish. Some are into fruit tree plantation.

iv. Early Maturing Varieties

These are varieties of various crops that mature early in order to capture the short rainy seasons that are experienced. Early land preparation ripping or planting basins for early planting crop rotation, Agroforestry planting *faidherbia albida* (Munsangu) trees, food preservation for use off season, utilizing of produce in a nutritious way cooking demonstrations, adding value to get more cash e.g. making peanut butter, mealie rice, samp instead of selling raw foods, selling of small livestock and their products gardening near dams and water pumps and using certified seeds which are early maturing.

d. How Are Compatibility Issues Related to Improved Crop Varieties and Local Community Perceptions in Uptake to Grow, Consume and Increase the Marketability of New Products?

The developed land preparation technologies under Conservation Farming Methods combine well with modern high breed varieties. When land is prepared appropriately and timely using modern tools it helps and facilitates the speedy establishment and growth of the modern and high yielding varieties. The uniformity, stability and value for use makes these varieties appealing for adoption among farmers leading to high productivity levels. This can also be noticed among emerging and small-scale farmers that diversify into horticultural production as they flood the market with modern varieties of tomatoes and cabbages of high quality. These products are marketable because of their value for use.

Rural households accept the new varieties only if the sensitization on the commodity has been done to them, they learn about the performance of the crop through demo sites or in other farmers' fields and are sure of a ready market as majority are accepting that farming is a business. They want to grow for both consumption and income. Farmers realised that improved crop varieties are better mature faster give more yields and better quality and marketable they depend on Agro-

dealers for field crop and horticulture seeds they rarely use recycled seeds because they were making losses.

We are confused on whom to follow. We have an extension officer, and then we have also other Organisations that come with inputs as well. Some of the teachings are too many and different depending on whom is supporting our Self-Help Groups (SHGs) with farming inputs. When you look at all these teachings, they just confuse us. BB2, BB8, BB11, BB17, BB28

From the study findings 74.4 % (64) respondents indicated that they apply conventional farming practices because it eases farm work. These findings imply that application of conventional/Western knowledge farming practices is popular due to their general simplification of food production process. These responses were confirmed by the focus Group Discussions

It is easy to follow the teachings of the extension officer regarding the western ways of farming. Besides that, if you do not follow to what is being preached, you may not access the inputs. These inputs come with guidelines. BB2, BB16, BB23

VI. CONCLUSION AND RECOMMENDATIONS

6.1 Climatic trends in Monze district

The first objective of this study sought to examine the climatic trends in the district from 1976 to 2014. The climatic elements examined were mean annual rainfall and temperature. Mean annual rainfall was found to have exhibited inter annual variations during the period with fluctuations of both high and low. The general long-term trend for rainfall was found to have been fairly steady during the period indicating that there had been no major change in rainfall activity in the district during the period under review. Instead, it was found that the usual seasonal variations of high and low rainfall characterized the period. Mean annual temperature on the other hand, like rainfall, showed variations, with fluctuations of both high and low annual temperatures. However, with regard to the long-term trend, it was found that there was a rising trend in this climatic element during the period. This rising trend was an indication that temperature in the district was rising.

6.2 Rural household food security situation in Monze district

The second object sought to establish the rural household food security situation in Monze district. The food security indicators used in the study were district level production of the staple (maize), period of household food shortage and households' perception of their food security situation. With these indicators, it was established that majority of the rural households faced food insecurity, though the situation was fluid as it depended on seasonal crop performance. A few households however, were found to be secure. With regard to the district level production indicator for instance, it was found that production had varied during the period under

review, characterized by episodes of high and low seasonal production. Because of the close link between production of the staple (maize) and rural household food security in the district, the food security situation could be said to have as well fluctuated, with high production improving the situation and low production causing insecurity. Generally, the study found that there was no evident long-term trend in production to show a specific bias towards either rural household food security due to increased production or insecurity due to a falling trend in production. Instead the situation was characterized by inters annual fluctuations.

In terms of the period of household food shortage, the study found that 78 percent of the rural households in the district experienced months of food shortage. It was established that these households were food secure three to four months after harvest. Thereafter, they faced food shortage and had to rely heavily on purchase of both maize grain and maize meal, while at the same time depending on relief food as well as food for work especially to those near Commercial farms. The reason for the shortage was that the quantity of the yield from their crops was not sufficient to last longer.

In terms of households' perception of their food security situation, the study found out that all the households were increasingly becoming worried of their food security and further described the situation as being insecure for their households. This was attributed largely to production of the staple crop which was described as having gone down as well as to the prices of the staple (both maize grain and maize meal) which had continued to rise posing a serious risk to household food security.

6.3 Effect of the climatic situation on rural household food security in Monze district

The third objective of the study sought to determine the effects of the climatic situation in the district on rural household food production, and hence rural household food security. Multiple regression analysis was used to establish this. The analysis showed that mean annual rainfall and temperature accounted for 12 percent of the variations in rural household crop production, and hence, rural household food security. More specifically, the effect was found to be positive for rainfall while temperature was found to have a negative effect. The positive effect for rainfall means that it had led to increased production while the negative relationship for temperature means it had led to reduction in production, thereby providing corresponding effects to rural household food security. An analysis of the two climatic elements reviewed that temperature had a stronger effect (11.8 percent) on production as compared to rainfall – whose effect was established to be negligible (0.002 percent). Therefore, generally production of the staple crop in the district had gone down due to the strong influence of rising annual temperature, thereby causing rural household food insecurity.

The third objective also sought to establish whether the relationship between climate variability and change (climatic

situation) with rural household food security was significant. Therefore, the study tested the null hypothesis which negated the existence of a significant relationship between climate variability and change and rural household food security. Rainfall and temperature were the dependent variables while district level maize production was the dependent variable in the multiple regression analysis. The analysis showed that both rainfall and temperature were not significant at alpha level 0.05. Therefore, there was not enough evidence to reject the null hypothesis. In addition, the contribution of both to production as indicated by objective 2 was 12 percent which was low. On the basis of this analysis, it was concluded that climate variability and change did not have a significant relationship with the rural household food security situation in Monze district. In other words, climate variability and change were not significant determinants of rural household food (maize) production and hence the rural household food security situation. Instead, the rural household food security situation in Monze district was largely on account of other factors outside of mean annual rainfall and temperature.

6.4 Climate change awareness among rural households in Monze district

The fourth objective sought to establish if the rural households in Monze district were aware of climate change. Overall, it was found that the respondents sampled were all aware of climate change. However, the knowledge of climate change was found to be informal, as it was based on individual experiences. It was also found that there were generally inadequate initiatives and programs at institutional level aimed at climate change awareness for the rural household. This scenario could have affected the adoption of climate change adaptation strategies.

6.5 Adaptation and coping measures to the food security impacts of climate variability and change

The last objective of the study sought to identify the coping and adaptation measures adopted by the rural households to mitigate the potential food security effects of climate variability and change. Adaptation was found to largely be based on planting of early maturing maize varieties (41 percent), while few households practiced conservation farming (15 percent) and others planted drought resistant crops like sunflower. However, more households (59 percent) had not applied any adaptation measures. With regard to coping measures, it was found that the households were largely diversifying their income sources as a way of earning incomes that would improve their food purchasing power. Some of the respondents had to either withdraw their school going children from attending classes or had to export their children to relatives in big towns who had capacity to manage extra children at School or help them with household chores.

In summary, given the positive relation between the effects changes in climate pattern and coping mechanisms as a strategy for food security, it can be argued that some of the negative climate-change adaptation strategies and poverty

levels indicated by the rural dwellers of Monze district of Southern Province are as a result of inadequate alternative livelihoods available, there is scope for policy to further promote the adoption of climate-change adaptation strategies. The results of this research on some of the compatibility issues related to improved crop varieties and how the indigenous people respond to the effects of climate change in Monze district of Southern part of Zambia revealed some interesting facts, which are unique in the context of Monze district and also have significant policy implications. This is because most of the rural communities rely more on rain fed agriculture for survival, and in times when food was insecure, they opted to charcoal burning for sale, sending their children to other relatives in big cities for school, men marry several wives as cheap labour and opt to heavy drinking habits.

6.6 Contribution to the study

The use of both qualitative and quantitative methods in this design enabled the researcher to use a higher number of respondents, with use of open ended questions in questionnaires, focus group discussions and the weighing of the children (under 5s). This enabled probing which yielded detailed information that has illuminated nuances and highlighted diversity within the Monze district context. The research design relied on varied data collection tools which were more suitable for this study since time and resources were limited. This study also equipped the study respondents of Monze district who were able to reflect on their experiences and managed to give insights of their indigenous knowledge. The use of several (Questionnaires, Focus Group discussions and weighing of Under 5s) enabled the researcher triangulate and allowed synthesis of both quantitative and qualitative data which was merged at the interpretation of results stage.

6.7 Conclusion

Based on the findings of this study, Monze district was experiencing climate variability and change characterized by a rise in annual mean temperature while rainfall had remained fairly steady during the period (1976-2014). There was also a relationship between the climatic situation in the district and production of the staple crop (maize), upon which household food security is founded. The rural household food security situation in the district had been negatively affected by the rising trend in temperature while rainfall largely had no effect. However, their effect was not significant, such that the rural household food security in the district was largely affected by other factors not included in the study.

On the other hand, rural households had employed some strategies to mitigate against the food security effects of climate variability and change. These were in the form of adaptation strategies that was mainly through planting early maturing maize varieties while coping was mainly through diversification of income sources which necessitated purchase of food during periods of shortage. These measures were

partly because the rural households were aware of climate change.

It can be argued that the rural dwellers of Monze district have been experiencing climate change for some time now as they use the indigenous knowledge to build shock absorbers. This resilience towards climate change has been respondent differently i.e. reduction in the number of meals each day, withdrawing their school going children from attending classes or exporting some of their children to other cities for education support or for some jobs. These inhabitants have also used a lot of farming technologies i.e. Conservation agriculture as a way of responding to the same climate change crisis.

In the entire district of Monze, climate change is very much felt in people's lives and is perceived to negatively impact rural production, household income, health conditions, and access to education. Slow-onset climate change impacts are contributing to or exacerbating human insecurity, particularly food insecurity, in all the six Chiefdoms (research study sites). In one of the most extreme examples, a respondent described this in terms of subjective fear.

6.8 Recommendations

In order to effectively deal with this minimum contribution of mean annual temperature and rainfall on rural household food security, the study recommends the following:

There is need for Ministry of Agriculture through its extension services and other agricultural organizations to encourage the rural farmers especially in traditionally maize communities (like Monze district) to begin to adopt other crops that may perform well under the current climatic conditions as opposed to reliance on maize even when it may not be performing well. Crops such as sorghum, millet, cassava and sunflower should be encouraged. This should be in addition to encouraging the households to grow variety so that they have what to rely on when one crop fails.

There is need to identify the poor and vulnerable rural households for proper targeting of climate variability and change policy strategies. This is because rural households are heterogeneous in terms of their natural, social, financial, physical, and human capital asset endowments. This means that the food security effects of climate change and variability are not the same among rural households.

- The rural households must be encouraged to adopt modern agricultural productivity enhancing technologies. To do this, government and its development partners must invest in agricultural modernization (like conservation farming) including construction of irrigation facilities in rural areas. There is need to increase the agricultural land under irrigation and introducing water saving techniques for maize production.

- The government through Ministry of Agriculture and the Meteorological Department together with cooperating partners should invest in disseminating accurate knowledge about climate change to the rural households in order for them to know formally what climate change is all about and what impact it has on their farming activities. A proper education brings about an increase in their level of awareness. Farmers should be equipped with knowledge on climate change, vulnerability and the adaptation measures that would help them in their farming activities.
- There is need for the Meteorological Department and its cooperating partners to work on strategies that improve on appropriation of climate and weather data in rural areas. This should be coupled with improvement in early warning systems for farming households to prepare themselves for forthcoming farming seasons.
- Encourage research that reflects accountability to climate-impacted communities, including approaches in which climate-impacted communities and people that are on the move because of climate change, are leading or co-leading research agendas and knowledge production.
- The research recommends that the principles and policy on Conservation Agriculture with Trees in sustainable agricultural development in Zambia should be developed and internalized (mainstreamed) in appropriate policies, regulations and guidelines. Appropriate indicators for the social, economic and environmental aspects relating to conservation agriculture with trees in sustainable development need to be identified through an appropriate consultative process or forum.
- The transformation of the Agricultural sector is a critical component of securing food amongst the growing population of the Zambians. This could be through providing emerging and small-scale farmers with the necessary services and conditions for them to increase their productivity. There must be scaling up access to agricultural inputs; improving extension services and research, introducing smallholder friendly technologies, improving access to local and international markets; reducing barriers to land acquisition, enhancing use of sustainable land management technologies; increasing investment in irrigation.

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