



A comparative study of the impact of climate change on food security in Limpopo and North West provinces of South Africa

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DECLARATION

I, Sylvia Mmamohapi Pheto, Student Number 16396138, do hereby declare that the dissertation entitled,

A COMPARATIVE STUDY OF THE IMPACT OF CLIMATE CHANGE ON FOOD SECURITY IN
LIMPOPO AND NORTH WEST PROVINCES OF SOUTH AFRICA,

is my own work and is submitted for the degree: Phd in Political Studies, at the University of the North
West. This work has not been submitted before for any degree or examination at any other University.

SIGNATURE OF STUDENT

DATE

ACKNOWLEDGEMENTS

I wish to express my sincere appreciation and thanks to God for giving me strength, wisdom and patience to complete this work. May all the glory and honour go to Him.

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DEDICATION

This work is dedicated to my Husband, Andrew Lekgotla Pheto, my sons, Olefile and Katleho and daughter, Itumeleng Pheto, parents, Lawrence Sehlare and Mmatshela Sehlare, who have been supportive from the beginning of my studies.

ABSTRACT

Food security is one of the most important global issues threatened by climate change today. The impact of climate change has become a reality that cuts across all sectors of life, locally and internationally. It threatens the existence of the human race through its direct impact on agriculture and eventually, global production of food. The aim of this study is therefore to assess how small-scale farmers, in the North West and Limpopo Provinces of South Africa adapt to climate change, in order to come up with sustainable and cost-effective adaptation strategies to curb food insecurity.

The question is how food security is affected by the changing climate, and how small-scale farmers adapt to climate change in these provinces. The study employed a qualitative research method where a purposive sampling technique was used to select participants. Small-scale farmers are classified into men and women and between the ages of twenty five and sixty five. Limpopo Province, ten women and five men, while North West Province has fifteen women and five men.

Interviews with unstructured questions were conducted, and discussions in focus groups of small-scale farmers were done to explore their knowledge and experiences on impact of climate change in their areas. Interviews were also conducted with two government officials from the Department of Agriculture in each province, two government officials from the department of Environment in each province. One official from the National Department of Agriculture, Forestry and Fisheries and one official from the National Department of Environmental Affairs.

Secondary sources used throughout the study included academic journals, database sources, reports from agricultural research centres, published research studies and relevant books. The responses received shows that due to severe effects of climate change, such as high temperatures, floods and droughts, it has been difficult for small-scale farmers to recover, due to poverty and this has compromised their agricultural production.

It has been identified in this study that food security is perpetuated by lack of employment in rural areas. This supports Sen's Entitlement theory, that it becomes difficult for poor people to access food when they lack assets to exchange or sell in order to buy food. When people are poor and climate change is not favouring them, even if they try to produce food, they end up being food insecure because they cannot afford to buy food during extreme weather conditions.

The study identifies adaptation strategies that small-scale farmers could use. They include; (a) Use of irrigation system and proper water management practices, (b) Diversification of crops and livestock, (c) Use of heat tolerant crops and livestock breeds, (d) Diversification of lifestyle and income to ensure sustainability of food supply.

The results indicate that government has a role in capacity building of rural communities in order to manage climate change risks; to provide financial support to small-scale farmers to enable them to adapt to the changing climate. Dissemination of climate change information through extension services has proved to be weaker and needs improvement to ensure that small-scale farmers are well informed about changing climate, its impact, mitigation and coping strategies.

Climate change cuts across all sectors of government and society, on this basis the study recommends that climate change be included in all aspects of planning for developmental purposes. The study also advocates for scholarships for more research on improving the existing mechanisms and technological innovations to assist small-scale farmers to cope with the impact of climate change. The findings revealed that small-scale farmers need to be assisted financially and technologically to adapt to climate change in order to ensure sustainable food production. The findings of this study may be helpful at various levels of decision making if small-scale farmers can be included in policy making processes to ensure improvement in the adaptive capacity of agricultural systems.

The study therefore concludes that with adequate support of government and the private sector in managing the risks brought by climate change impact, food security can be achieved.

Key Concepts: Climate Change, Food Security, Adaptation Strategies

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LIST OF ABBREVIATIONS AND ACRONYMS

AAP	:	African Adaptations Programme
AU	:	African Union
CAADP	:	Comprehensive African Agriculture Development Programme
CDM	:	Clean Development Mechanism
COP	:	Congress of Parties
CRDP	:	Comprehensive Rural Development Programme
DAAF	:	Department of Agriculture, Forestry and Fisheries
DBSA	:	Development Bank of Southern Africa
DEA	:	Department of Environmental Affairs
DEAT	:	Department of Environmental Affairs and Tourism
ECOWAS	:	Economic Community of West African States
FAO	:	Food and Agricultural Organisation
GDP	:	Gross Domestic Product
GEF	:	Global Environmental Facility
GHG	:	Green House Gas
GECFS	:	Global Environmental Change and Food System
HEA	:	Household Economy Approach
IFPRI	:	International Food Policy Research Institute
INC	:	Intergovernmental Negotiating Committee
IPCC	:	Intergovernmental Panel on Climate Change
LDA	:	Limpopo Department of Agriculture
LDCF	:	Least Development Countries Fund
LDC	:	Least Developed Countries

LEDET	:	Limpopo Department of Economic Development, Environment and Tourism
NAP	:	National Adaptation Plans
NAPA	:	National Adaptation Programme of Action
NAIP	:	National Agricultural Investment Plans
NDA	:	National Development Agency
NEMA	:	National Environmental Management Act
NEPAD	:	New Partnership for African Development
NWP	:	Nairobi Work Programme
NWPC	:	North West Planning Commission
NWPG	:	North West Provincial Government
NW READ	:	North West Department of Rural, Environment and Agricultural Development.
REC	:	Regional Economic Countries
RISDP	:	Regional Indicative Strategic Development Plan
RSA	:	Republic of South Africa
SADC	:	Southern African Development Countries
StatsSA	:	Statistics South Africa
SCCF	:	Special Climate Change Fund
SIDS	:	Small Island Developing States
SLA	:	Sustainable Livelihood Approach
UNDP	:	United Nations Development Programme
UNFCCC	:	United Nations Framework Convention on Climate Change
UNRAVEL	:	Understanding Resilient Vulnerable Livelihood

WCC : World Climate Conference

WHO : World Health Organisation

CHAPTER ONE

GENERAL INTRODUCTION

1.1 BACKGROUND

Climate change is a global issue that has put all living beings under threat. Global communities are challenged by the impact of climate change currently and in future. This, according to United Nation Development Programme (UNDP, 2008), is the debt of humanity that the future generation will not be able to repay, if the current generation continue not to protect their environment well. Equally, the effect of the current population living beyond their environmental means and destruction of the ecology, will lead to the end of the world.

Global food production is in danger through the changing climate as the agricultural sector depends on good climatic conditions to thrive. With the current climate change impact, food production and food security are declining. This does not only affect developing countries, but even developed countries are affected. The only difference is that developed countries are at an advantaged position due to their capacity to adapt to the effects of climate change, and developing countries lack capacity to implement effective and appropriate adaptation measures.

Agricultural production is the main source of livelihood in most African countries as it does not only provide food security but it is also a source of income in most rural communities. There is enough evidence of the changing climate and its impact on the availability of food for all people, especially the vulnerable poor people living in rural communities.

Climate change and global warming are often used interchangeably but, according to National Aeronautics and Space Administration (NASA) (2008), climate change encompasses global warming, but refers to the broader range of changes happening in the planet such as accelerating melt of icebergs and shift in flowers and plants blooming times. They are all consequences of warming caused by humans. When people burn fossil fuels they put into motion heat trapping gases such as carbon dioxide.

Although humans are responsible for global warming, it is also their responsibility to stop emitting greenhouse gases in order to reduce climate change. Climate change takes many decades and it takes the earth decades as well to respond to climate change. This means that it takes decades for the trapped gases to effect climate change. On the other hand, it takes much time to feel human impact on climate change. If no major action is taken to reduce emission, global temperature is likely to rise by an average 6 °C. NASA, 2017.

However, research has shown that it is never too late to limit the impact of climate change. (NASA, 2008; IPCC, 2014) Globally, two things need to happen in order to respond to climate change. (1) Adaptation –

which requires people to learn to live with and adapt to the changing climate that has already been happening. (2) Mitigation – that requires reduction of the flow of green house gases into the atmosphere. It remains a concern how the entire world will emit carbon dioxide and other pollutants. Because climate change is a global issue and a very complex phenomenon, it has political, economic, social and moral ramifications. Responding to it requires well coordinated global solutions such as international prescripts, policies and agreements between states for a commitment to cleaner forms of energy.

Most scientists and researchers on climate change agree that climate change is caused by humans. Even though scientists that endorsed the consensus are estimated to be more than 97.1%, there are still other researchers that express a differing view on the matter. Nevertheless, this was also a position of the Intergovernmental Panel on Climate Change (IPCC, 2013, Cook, 2013).

Ding et al., (2011), state that it is important for the global public to understand climate change and its impact so that it becomes easy for governments to facilitate the coping systems and mitigation of greenhouse gases. However, it is clear that due to lack of understanding of climate change, there is a significant gap between public perception on climate change and the reality. This delays the public's commitment to adapt to the impact of climate change.

South Africa is also vulnerable to the impact of climate change due to its dependence on climate sensitive economic sectors, such as agriculture and tourism, which are not able to create sustainable employment for rural communities. Although in South Africa the agricultural sector is divided into commercial and small-scale farmers, the latter remains more vulnerable to the impact of climate change due to their lack of capacity to adapt to the effects of the changing climate. (Madzwamuse, 2010).

South Africa is projected to experience reduction in rainfall patterns, increasing temperatures and frequent extreme weather events such as floods and droughts, due to the changing climate (Nhemachema, 2008). It is also expected that these would have a direct impact on the livelihoods of South African citizens, in particular those living in rural areas. The changing climate will continuously affect the country's ability to reduce poverty to improve food security and eliminate water scarcity.

In South Africa, agriculture is vulnerable because it is highly dependent on climate variables, such as unreliable rainfall and temperatures. The effects of climate change on agricultural production include, (a) rising production costs, (b) unreliable and unpredictable weather patterns, (c) increased incidents of diseases and pests attack, (d) reduction in crop yield, (e) reduction in livestock production, (f) reduction in the fertility of soil and land degradation, and (g) shortage of water. South Africa already has poverty, unemployment, HIV/AIDS, low levels of education and inequality legacy of apartheid and climate change is an additional stress to the country's economic development. (Maponya, 2012).

This study focuses on North West and Limpopo Provinces of South Africa. The impact of climate change on both provinces is already visible. Both economy and natural resources that rural livelihood depends on are at risk due to climate change. Increased weather patterns and extreme weather conditions brought by climate change are already reducing the yields and the availability of food in the rural provinces. The amount of water available is lessening by the day due to shortage of rainfall and droughts. Biodiversity and ecosystems are continuously degraded.

According to Nhemachena, 2008, rural communities depend on rain fed agriculture but due to changing climate, they are no longer able to produce enough, instead they are fast pushed to poverty by droughts and high temperatures, which do not allow them to practise farming anymore. Agriculture has been a major source of food and employment for a long time for rural communities, but due to the changing climate, many had to migrate to urban areas to find alternative ways of survival. However, the reality posed by climate change is that even urban areas are already feeling the heat. (Nhemachena, 2008).

As the rural population in South Africa grows from the apartheid era to the democratic era, and the demand for land, energy, food and water rises, poor communities continue to suffer, as they are faced with inefficient allocation and use of resources, and rising prices of food and energy. All these add up to the ecological challenges that put strain on agricultural livelihoods. A combination of all these challenges means that agrarian rural communities now face a new livelihood challenge of food insecurity and shortage of water (Noble, 2010; James, 2015).

Rural communities remain vulnerable to climate change due to poverty. There is an agreement amongst researchers that food security in rural areas is supposed to be boosted by agricultural production, but the changing climate has made it difficult for some households to cope with the severe effects (Ngigi, 2009; Noble, 2010; Nerves and DuTouit, 2013)

It is equally important to understand the relationship between climate change and food security in the context of rural communities. Climate change on its own is confusing to some people as it is characterised by extreme hot and extreme cold, extreme wet and extreme dry weather, which all affect food systems. How food is produced depends on good weather patterns that balance the agricultural seasons, however, food accessibility, food availability, and the utilization of food are affected by the changing climate (Ziervogel, 2015).

Food availability depends on climatic conditions, and this is already evident in South African rural areas (StatsSA, 2014). The impact of Climate change is already felt by small-scale farmers as food producers due to extreme weather events such as draught and poor rainfall. According to Nerves and DuTouit, (2013) these events threaten future production of crops. High temperatures are already negatively impacting on low existing yield and the quality and quantity of crops are affected by low rainfall.

Food access has already put most rural communities at poverty level. Due to shortage of food in South Africa, prices have gone high making it difficult for poor people to afford food. Most vulnerable poor people from rural areas can not afford to produce even their staple food, due to low agricultural output. According to StatsSA, (2017) even the low income they earn out of agricultural produce has gone down, to a point where others even lost their jobs. Under the circumstances poor people who have already committed their income on food, sacrifice their assets in order to be able to buy food, those without assets depend on government grants or face hunger.

Food utilization in most rural areas is a critical issue, as for most people who live in poverty are vulnerable to poor nutrition related illnesses, and climate change in its form has created a vicious cycle of illness and poverty. Poor people do not have a choice on what they eat, they just eat what is available even if it is not healthy. Imagine a situation where people cannot produce their own food and are forced to buy food, which they can not even afford. The only option they have is to buy the cheaper food which in most cases is less nutritious. For the vulnerable poverty stricken people, characterised by poor nutrition related diseases, they endure double trouble as they are unable to maintain their dietary requirements.

When people are poor they lack food stability. When people do not have income even if food can be available they may not have access to food. The accessibility of food depends on whether food is available. People in rural areas, move from rural to urban areas in search of jobs to enable them to access food. This instability affects government food security strategies as people keep on flocking to towns and cities in search of employment and others come from neighbouring countries such as Zimbabwe, Lesotho and Mozambique, where there is shortage of food and instability. These are all results of climate change and cause food availability to fluctuate and food access to be reduced (Mazvimavi, 2010; Langba, 2014; StatsSA, 2015).

According to National Development Agency (NDA) 2014 report on the status of poverty in South Africa, Limpopo, Eastern Cape and Kwazulu-Natal are poor rural Provinces. North West Province is not rated amongst the poorest, although it is over 60% rural. The history of rural areas in South Africa flows from the skewed nature of segregation of communities during the apartheid era and mostly associated with previous homelands (NDA, 2014; StatsSA, 2015).

In both Limpopo and North West Provinces, agriculture is the pillar of economic development. Agriculture contributes 3% of the GDP in the North West and 2.2% of the Limpopo's GDP StatsSA, (2015). As an important sector for food security, it is therefore necessary to understand changes in food production already taking place, in response to climate change. The two provinces are both mostly dry and have very hot summers. They have distinctive characteristics of rural areas, such as underdevelopment, and they are sparsely populated with less civilization. They depend greatly on agriculture and natural resources, which make them very sensitive and vulnerable to climate variations,

extreme climate events, and climate change. These provinces have existing vulnerability caused by poverty, lower levels of education, low level of income and unemployment.

Both provinces are experiencing extreme weather events arising from the phenomenon of changing climate. Floods have destroyed fields and crops, storms destroyed rural infrastructure and caused loss of lives between 2013 and 2017, the recent one happened in February 2017 in the North West Province, where four people were killed after being swept away by water. In January 2017 five people drowned and died while trying to cross the flooding river in Limpopo. The floods also had a severe impact on agriculture and other ecosystems which rural communities depend highly on. Heat waves have caused veld fires, droughts and high temperatures have also caused severe livestock and human diseases (News24, 2017).

The type of houses in rural areas are poorly built, poorly located with no lightning protection, which has always put them at a risk during bad weather. When there are floods houses are easily destroyed and often owners have to rebuild or relocate to other areas, which comes at a cost (Magoro, 2010). Mostly, people who live in rural areas are poor people and they are susceptible to illnesses caused by uneven temperatures and bad weather. This promotes stresses about food security and malnutrition.

According to StatsSA, (2015), people living in rural areas of South Africa live in poverty; they are unemployed, which reduces their ability to recover from the climate shocks. Rural communities depend on farming, not because they like it, but for survival. People living in rural areas without secure tenures such as squatters are less likely to invest in farming as they are not allocated enough land either for crops or livestock.

Rural areas are physically isolated; as a result they have poor roads and are vulnerable to flooding and erosion. The other factor affecting rural areas is the responsibilities of both the local authority and the traditional authority. The authority between the two institutions is not clearly demarcated and is not exercised in a democratic and equitable manner with respect to allocation of land and land use rights. North West and Limpopo Provinces have issues of land that needs to be redistributed to the rightful owners (Cousins, 2014).

Even though it has not received enough attention in rural areas, the issue of arable land lost due to reduced suitability for crop farming is a blow to farmers. Yes, it has been proven that some crops do better in more heat than others. For instance, sorghum is a heat-tolerant crop and maize grows better where there is rainfall, however, rural communities in their unique way have their traditional preferences of food, some are used to eating maize and prefer it as their staple food and may not want to switch to sorghum as a better staple food, as a result once maize does not do well in their fields, they stop farming.

Although the two provinces have similar characteristics in some aspects such as rural nature, unemployment and low income levels, they do differ in other aspects such as their population size. Limpopo has population of about 5 404 868 million over an area of 123 910 square kilometers, and North West has 3.5 million people living in an area that covers about 106 515 kilometer square. Limpopo is 90% rural while North West is 64% rural, and Poverty level of Limpopo is at 12.6% while North West is at 8.2%. (DAFF, 2016; StatsSA, 2011).

Amazingly, rural communities have had a way of coping with climate change despite their economic situation. More research has been done on climate change and commercial farming and urban communities; less is said about the rural areas and small-scale farming (IPCC, 2014; DAFF, 2016). The gaps on similarities and differences in both Provinces on how climate change impact on the availability of food should be able to help to close the gaps on peculiarities. It is therefore important for South Africa to develop and implement effective adaption and mitigation strategies so that all climate related risks are dealt with.

The main focus of the thesis is on the small-scale farmers. To find out what they perceive to be the impact of climate change on food security, the challenges they face and how they cope with the changes. Climate change is found to have negative impact on these farmers who have no social security safety nets or resources to cope with climate change (Thompson, 2010). The study also establishes what more could be done in terms of managing the unavoidable (adaptation strategies) and avoiding the unmanageable (Mitigation) of the impacts of climate change.

The concerns regarding climate change have triggered a wide range of studies on the economic impact, more specifically the impact on agricultural inputs that could be used in future to ensure sustainable food availability. It would therefore be crucial to have studies on the economic impact of climate change that focuses on the global, regional and national or provincial scenarios (IPPC, 2014).

The rationale of this study arises from the growing concerns on social and economic inequalities that put the small-scale farmers at disadvantage, due to lack of information. Farmers need understand the magnitude of the impact of climate change, their farming systems and what it means to their food security.

The study is important because it came up with recommendations on approaches and policies to adopt in order to cope with climate change and hence ensure food security in decades to come. The findings from this study will assist policy makers and other stakeholders in agricultural development and disaster management sectors of government. It will also provide knowledge and awareness to citizens linked to agriculture, food security and poverty alleviation program for advocacy purposes.

The above background explains why the study was undertaken. However, this study should form part of a credible body of evidence that will be used by government, institutions, even the generations to come to address the impact of climate change on food production in rural areas.

1.2 PROBLEM STATEMENT

The IPPC (2014), found out that there was more research on the impact of climate change in commercial farming and for commercial farmers, but not much is said about small-scale farmers and how they are affected by climate change. This scenario is worrying, especially in countries such as South Africa which has a high population in rural areas. Rural population in South Africa was measured at 35.20% in 2016. (StatsSA, 2016). Small-scale farmers in rural areas are devastated by changing climate. It would also be a crisis if small-scale farmers in rural areas were to stop producing food due to extreme floods or droughts and high temperatures. Evidently, most people would die of hunger.

According to FAO (2015), people living in poverty are unable to sustain their food production, more especially when they are vulnerable to effects of climate change. People who depend on traditional farming often opt to leave their homes to go to cities and look for jobs when they realise that their farming is declining due to the unreliable effects of climate change such as change in rainfall patterns and temperatures. Due to the growing population in cities and urban areas people who do not find jobs often turn to crime and other illegal activities in order to make ends meet.

Due to low levels of education in rural areas, it is difficult for people to find jobs especially when there is shortage of employment in the entire country (StatsSA, 2016). Those who cannot leave their home, stay to farm at a loss, others spend some days with nothing to eat. What makes it even worse for subsistence farming in rural areas is that there is shortage of water, which makes it difficult even to have a small vegetable garden. In other parts of the North West such as Disaneng village, those who have livestock often share drinking water with their livestock.

Climate change weakens the rural economy due to reduced agricultural production in rural communities. This is due to the effects of climate change such as floods, droughts, rising temperatures, and unreliable rainfall patterns. Agriculture in rural areas has been negatively affected and making farming difficult for farmers. Small-scale farmers in rural areas depend on farming as a source of income, employment and others are farming for domestic consumption (James, 2015).

During 2015/2016, AgriSA (2016), reported a decline in food production due to severe drought that affected agricultural sector in South Africa. Drought which affected major production outputs such as crops and livestock, had adverse effect on the financial position of farmers. When food production is affected, farmers had to reduce their production and workers to manage their costs. This caused unemployment for

many others who are on the food chain. When people lose their income and purchasing power, they become food insecure.

It has also been found by Statistics South Africa (StasSA) (2011), that due to the remoteness of rural areas, it is difficult for farmers to have proper markets due to lack of infrastructure and lack of basic services. The government programme of rural development also takes too long to reach all the rural communities. According to Tapela et al, (2016), service delivery protests are done by frustrated rural communities who struggle to get assistance from the government. They vary from demands for water, electricity, and poor road infrastructure to other things which are necessary for agricultural and economic activities that could improve rural farming.

1.3 AIM OF THE STUDY

To assess how small-scale farmers adapt to climate change in order to come up with sustainable and cost effective adaptation strategies to curb food insecurity.

1.4 OBJECTIVES OF THE STUDY

The objectives of this study were to assess the impact of climate change on food security in Limpopo and North West Provinces of South Africa. The secondary objectives are as follows:

- To determine how small-scale farmers in Limpopo and North West Provinces adapt to climate change.
- To identify effective adaptation strategies adopted by small-scale farmers in Limpopo and North West Provinces to curb food insecurity.
- To determine the role of government in addressing the risks and challenges relating to climate change and food security.

1.5 RESEARCH QUESTIONS

The primary question of the study is how food security is affected by the changing climate in the North West and Limpopo Provinces of South Africa? Secondary research questions are as follows:

- How do small-scale farmers in Limpopo and North West Provinces adapt to climate change?
- What effective adaptation strategies are adopted by small-scale farmers in Limpopo and North West Provinces to curb food insecurity?
- What is the role of South African government in addressing risks and challenges relating to climate change and food security pressures?

Answers to these questions must lead towards reducing the vulnerability of small-scale farmers to the impacts of climate change.

1.6 SIGNIFICANCE OF THE STUDY

Research on climate change and rural communities have shown that small-scale farmers are vulnerable to the impact of climate change as they are more exposed to climate risks by their economic status (James, 2015; Baiphethi and Jacobs 2009). Based on the physical risks such as droughts, floods and extreme weather events, posed by climate change with regard to rural livelihoods, water, food and economic security, it is important that appropriate responses to these risks be identified. This should take place at local, regional and at national levels to ensure that small scale farmers are well considered when policies are drafted. Small-scale farmers as food producers need to be empowered to advocate for the mitigation on emission of gases to manage climate change impact.

Small-scale farmers also have the responsibility to identify appropriate measures to enable them to cope and adapt to the impact of the changing climate. The implication for them not participating in the adaptation strategies will leave them vulnerable to climate change.

The South African Constitution Act 108 of 1996, Chapter 2, Section 27,1b states that every citizen has the right of access to sufficient food and water, and it gives mandate to relevant government departments to ensure that everyone has access to enough food at all times. However, in the rural communities of Limpopo and North West provinces of South Africa, this is farfetched. It is well known that South Africa produces sufficient food at national level but its rural communities do not enjoy that sufficient food as a result it becomes a challenge to even talk about individuals and households. Due to climate change most small-scale farmers are forced to buy food when their yield is not good, so this is even worse for those who do not produce their own food and cannot afford to buy themselves food.

Poverty and climate change will always relate when food security is concerned because where there is poverty it becomes difficult to cope with the impact of climate change and therefore food security is almost nonexistent. When coping strategies are identified by small-scale farmers, their point of departure should be rural development, as a strategy to reduce rural poverty, therefore the mainstreaming of climate change in all policies and food security programmes will be more essential in order to achieve and sustain food security.

This study therefore contributes towards advocating for appropriate adaptation measures and mitigation to climate change by agrarian communities in rural areas. This is an effort to improve on the existing different mechanisms and enabling small-scale farmers to identify and incorporate them with best agricultural practices. It is a fact that there is more research on the impact of climate change on commercial farmers and less is known about the impact of the changing climate on small-scale farmers and the implication on food security.

This study contributes to the existing body of knowledge and government with its relevant departments, such as agriculture, environment, climate change and food security; civil society organisations including the interested private sector. Equally, academics will also benefit from the findings of this study. This may influence more research and debates on best climate change adaptation practices that influence more sustainable food production and food security.

Due to their lack of resources, small scale farmers do not have more options to respond to the impact of the changing climate. There is enough evidence that climate change is not only about regulating greenhouse emission in the atmosphere, but affects on human development, human rights, equity and social justice (O'Brien, 2008). In addition, Barnett et al, (2008) relate that climate change is also about human security and the capacity of individuals and their communities to respond to the threats posed to their environmental, human and social rights.

1.7 LIMITATIONS OF THE STUDY

The major limitation was to secure appointments with the respondents. They kept on changing dates on availability, especially those that are in Limpopo which was far from where the researcher resides. The study was a self-administered work as a result this caused some delays in terms of data collection. Even though some respondents were a bit reluctant to provide the information at the beginning, they gradually relaxed towards the end of the interview when they realised that questions were mainly about climate change and food security and nothing political. However the fact that interview was conducted in their own language made them really comfortable to discuss freely and openly about their experiences.

1.8 SUMMARY

Chapter one covered the general introduction to the study, and the problem statement. The aim and objectives of the study are highlighted in this chapter. The methodology is clearly discussed in chapter three.

CHAPTER TWO

REVIEW OF LITERATURE AND FRAMEWORK

2.1 INTRODUCTION

For purposes of understanding the problem identified in this study, existing relevant literature needs to be revisited and reviewed in order to identify similar work done on the field of study. Considering that, there are many interpretations and definitions relating to climate change and food security, it is important to define the key concepts to the study. This section therefore presents discussion on these concepts and their relevance to this study. Important concepts in this study include climate change, food security, and climate change adaptations.

2.2 CONCEPT OF CLIMATE CHANGE

As defined by the United Nations Framework Convention on Climate Change (UNFCCC), climate change is a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global and/or regional atmosphere and which is in addition to natural climate variability observed over comparable period of time (Onyeneke and Madukwe, 2010).

The Intergovernmental Panel on Climate Change (IPCC), also defines climate change as the state of the climate that can be identified by using statistical tests, to determine the change in the mean and/or the variability of its properties, and that persists for an extended period of typically decades or longer (IPCC, 2007).

Even though the earth is constantly moving and its climate changing, the change in climate occurs naturally. The change in climate in future may be more rapid than the past years. The conclusion by majority of scientists dealing with this topic concluded that climate change would occur and would differ from previous one due to the fact that human activities have also changed. The observation by Koehler-Munro and Goddard (2010) has been that the atmosphere has an effect like a greenhouse on the earth's atmosphere. So the energy that comes from the sun reaching the earth is balanced by the energy that the earth emits back to the atmosphere. Therefore the Greenhouse gases (GHGs) trap some of this energy that the earth releases to the atmosphere. Without the natural greenhouse effect, the average temperature on earth would be 18⁰c instead of the current 15⁰c.

The modern industry and lifestyle have put the earth to where it is today. The levels of greenhouse gases have risen. Gases such as carbon dioxide, methane and nitrous oxide have had a huge impact on the climate change. Human activities have also increased the levels of greenhouse gases by destroying forests that used to protect the land from the sun, and which removed greenhouse gases. By burning of fossil fuels on day to day basis also made a big contribution to climate change. (Koehler-Munro and Gaddard,

2010). This leaves people with the responsibility to care for their own environment and that includes finding good models to adapt and mitigate climate change impacts.

2.3 CONCEPT OF ADAPTATION

According to Adgar et al., 2007, adaptation to climate change is an adjustment made to climate change as changes in agricultural management practices in response to changes in climate conditions. There are however, various adaptation that can be used, (i) autonomous and planned adaptation, (ii) anticipatory and reactive adaptation and (iii) private and public adaptation.

It is important to adapt to climate change as its impacts can lead to extinction. Autonomous and planned adaptations are those that take place in reaction to climatic stimuli, without the intervention of any public agency. This is widely initiated by private actors rather than government, and triggered by the markets or welfare changes in the lives of the people. The anticipatory and reactive adaptation are based on the awareness that conditions are about to change or have changed, and that the action may be required to minimise losses. The private and public adaptations, the responses will be evaluated by both government and private companies in terms of cost and benefit. This needs a good relationship between public and private sector to put efforts together and offer incentives such as capacity building, insurances, investments, and financial assistance to those who desperately need it to improve their adaptive capacity. (Adger et al., 2007). When adapting to climate change people are given a chance to participate in improving their environment and taking good care of it for the benefit of current and future generations.

2.4 IMPACT OF CLIMATE CHANGE ON FOOD SECURITY

There is a consensus that climate change is a global threat that is expected to have negative impact on human system National Aeronautics and Space Administration (NASA), (2008). Climate change refers to long-term changes in average weather conditions covering all changes in the climatic system, including drivers of change, the changes themselves and their effects. The earth's climate is always changing, there has been warmer years and cooler years in history, however these changes has made big effects on earth.

Although many things can cause climate to change, the most commonly talked about is the people burn fossil fuels to heat their homes, when they cook food, and the smoke that comes from their cars and industries, also cause the gases that makes the air to heat up. When the earth's temperature keep on rising, over the years snow and ice would melt, oceans would rise and some places would get hotter and others would colder and more hurricanes. Although it affects all the regions the only difference is how different regions cope to its impacts (Ludi 2009). Africa is amongst the vulnerable regions based on its economical, political, and social constraints that push its communities to be vulnerable to climate change, leading to high prevalence of food insecurity (Hope, 2009).

Climate change projections in African region including South Africa indicates that there is an increase in temperature warming, rainfall decrease and where it does rain, it is likely to increase in intensity and sporadic events (Boko et al., 2007; Christensen et al 2007). These changes have proven to have negative impacts on food production through reduced yield, increased food prices and the entire agricultural sector.

According to Smith, (2014) agriculture is one sector that contributes to climate change, as it is a result of emission of greenhouse gases such as carbon dioxide, methane and nitrous oxide. Cousins (2013) indicates that when agriculture grows through its increased intensive energy and chemical farming, levels of greenhouse gases increases. As the land is cleared for agricultural purposes, fertilizers are used and intensive farming and deforestation takes place, more carbon dioxide is released into the atmosphere exacerbating climate change.

Agriculture is the major source of food security that needs to be enhanced as far as climate change is concerned. It is also a solution to the impact of climate change, therefore through appropriate adaptation measures and enhanced agricultural practice impact of climate change on food security can still be managed by advocacy and policy. Government and policy makers have a challenge to ensure that climate change does not frustrate agriculture to a point where food production is impossible. There is a need for constant engagement with people (farmers, rangers, energy producers, miners and manufacturers) at different levels to capacitate them on climate change and how it could be managed (IPCC, 2007).

Research has shown that climate change negatively impacts food security (Wlokas, 2008; Thompson, 2010; Ludi, 2009; FAO, 2010 and Zewdie, 2014). According to Thompson (2010), climate change is another challenge on the way of developing countries to reach their potential in breaking the cycle of poverty and malnutrition. Rain fed predominance in Africa's agriculture results in food systems that are highly sensitive to rainfall variability. Without good rain, food production is likely to fail and shortage of food prevails.

According to Food and Agricultural Organisation (FAO) (2010), climate change affects food security through its impact on all components of global, national and local food systems. In support of the notion, Ziervogel (2008) also shows that Africa will be affected negatively by the impact of climate change through its extreme weathers such as floods, droughts, storms and heat waves. These will have negative consequences on food production making it difficult for availability, accessibility and utilization of food, particularly by poor people. Food crisis caused by the severe effects of climate change, such as low and unseasonal rainfall have been felt by people in Zimbabwe, Malawi and Zambia.

The impacts of climate change has also been felt by South Africans in several ways. Nhemachena (2008) indicated that climate change will affect crop production and yield, which will influence price increase especially on maize, wheat and sorghum. Gbetibouo et al., (2010) also emphasise that farmers in the

North West, Limpopo and Eastern Cape are more vulnerable to climate change impact due to their rural nature, which characterises them as underdeveloped and with no drought tolerance varieties. This is admitted by Greyling (2012) that climate change is threatening South Africa's food security and increasing more poverty especially in rural areas where people cannot afford to buy food due to the high rate of unemployment.

Food security situation has been expressed by Maponya (2012) that climate change poses a serious challenge in food production in South Africa. She further mentions that with extreme weather patterns and unreliable rainfall, agriculture in general is threatened. The agricultural sector is facing three challenges (a) shortened growing seasons and the decrease in yield, (b) reduced amount of arable land and pastoral land for livestock. (c) Shortage of water. These affect growth of food production and reduce the agricultural sector's contribution to the national Gross Domestic Product (GDP).

2.4.1 FOOD AVAILABILITY

Climate change is affecting all three dimensions of food security, namely, food availability, food accessibility and food utilization (Bryan, 2009; Rahim, 2011). According to Lal (2009), availability of food is a key in food security. In most African countries including South Africa, farmers rely on subsistence farming for food and their farming is dependent on climatic sensitive weather. It is important to mention that even though South Africa still exports some food to other countries, it does not mean that there is enough food available. Small-scale farmers rely entirely on good climatic conditions while commercial farmers use irrigation systems that enable them to produce enough.

During climate change involving droughts and floods, farmers experience a decrease in their food production. Bryan (2009) indicates that lack of rainfall and high temperatures have a negative impact on growth and duration of crop production and, as a result crop production decreases causing shortage of food. According to Maponya (2012), crop production is negatively affected by infertile soil and shortage of water. Poor small scale farmers do not predict and plan for extreme events, and their capacity to adapt is very low, as a result they fall victim to the effects of climate change. It is important to note that due to their incapacity to cope even the irrigation system that would serve as an adaptive measure to them, they need financial assistance and technical support to use it. Gbetibouo (2009) still suggests intensification of land use in order to cover more land with agricultural activities. However, more water will be needed to increase yield. The implication is that with extreme weather events, food production is likely to be very poor and food insecurity will be increased.

According to Osbahr, (2008), climate change has severe impact on food availability, in particular vulnerable subsistence farmers who do not have capacity to deal with droughts that cause soil infertility. The floods also cause soil erosion and soil degradation. This creates a challenge for them as lack of good

quality soil reduces their yield potential and leaves them food insecure. In the study by Mpandeli (2012) in Limpopo, a province in South Africa, small scale farmers were encouraged to use organic manure such as compost to improve the soil quality after extreme weather events and their yield was increased.

However, Rahim (2011) encourages that food availability is dependent on people's ability to create other means of getting food other than being into actual farming. Food availability is all about food production or food stock. It is important to mention that although there is little research made on climate change resistant seeds, it is important to use genetic modification or identify the drought resistant crops that could survive in unfavourable climatic conditions. Madzwamuse (2012) suggests that crop diversification especially with staple food, can cause food insecurity if implemented by small-scale farmers to ensure availability of food. He maintains that domestic production, presence of food stock and availability of social protection measures are key to food availability.

2.4.2 FOOD ACCESSIBILITY

According to Ludi, (2009), food accessibility refers to the ability of individual, organisation or a country to buy enough quality food. Mugabe (2014) qualifies it to say that food accessibility incorporates the physical, social and economical means of making food available. Ziervogel (2010) on the other hand found that food accessibility fails in households and communities due to rising food prices, poor access to markets, poverty, unemployment, low levels of education and lack of property rights.

According to Bals et al., (2008), small scale farmers rely on subsistence agriculture, which is rain fed. During extreme events, they are left with no food to eat or no money to buy as they would have also been affected. They are therefore vulnerable due to their poverty, which is a central element when it comes to food accessibility. Their poverty and vulnerability are major elements that determine their buying power and their social dynamics that govern access to food. It is important to mention that normally, during June to August, there used to be less food available for producers hence termed "hungry season" by Zewdie (2014) with the changes in climate during that period is predicted to be longer than it used to be, which then means that people will need more food or money to afford the food during this period.

According to FAO (2009), food accessibility is affected by rising food prices, loss of jobs which then translates into less access to food. As the population grows, the demand for food increases, food prices go up and the supply of food and imports become expensive. This has a very negative impact on small-scale farmers because if they do not produce enough they will not have surplus to take to the market. or they will not be able to get an income out of their produce. This emphasises the suggestion by Maponya and Mpandeli (2012) that as the impact of climate change is becoming more severe on farming, small scale farmers may consider off-farm employment and join other sectors to maintain the access to food by their households.

Langba (2014) found out in the study on economics of food that with the absence of reliable markets there is lack of access to food. As most communities in poverty stricken areas depend on subsistence production of food, it is important to have markets as a secondary source of food. Zewdie (2014) indicated in his study that, generally, there has often been a hunger seasons from June to August when there is shortage of fresh food. The diversification of livelihood was found to be appropriate in order to cope with the impact of climate change.

The study then notes that there are no longer reliable food availability seasons like it used to be decades ago. The demand for food today is such that without food market there would be a total shut down of food accessibility. The rising food prices and the decline in income growth due to climate change has been a new threat to food security in most countries (Ziervogel, 2010).

2.4.3 FOOD UTILIZATION

According to Thopson (2010), food utilization is about how food is used by different individuals, households and communities. It is important to ensure that consumed food has enough nutrients to maintain a healthy life. According to CARE (2011), food utilization is the capacity of individuals and communities to consume and benefit from the food in a healthy manner. FAO (2011) takes it further to show that depending on age, health and diseases, people will always differ in how they utilise different types of food. To qualify the definition of food security, it is important for those who consume food to ensure that it meets the health dietary requirements. It can also be noted that with the impact of climate change that reduces crop yield, it becomes difficult for people who do not earn much to buy expensive nutritious food, in the midst of less costly and less nutritious food.

According to Mallikarjuna (2013), food utilization also relates to the social value of food in terms of how it is used by different traditions. For example, in some traditions, some categories of food that are said to be nutritional are forbidden as part of tradition. In some traditions people are forbidden to have food during fasting periods. These practices are very relevant in determining the quality of food intake by different communities.

Wlokas (2008) found out that even in the presence of food availability and food access, food utilization is not met. Most rural communities where there is unemployment and high levels of poverty, with climate change and hiking food prices, households are forced to minimise their intake of food or buy food they do not prefer only because they are affordable to them. For example, in the study by Maponya (2014), some people of Limpopo reduce their food intake to one meal per day, due to shortage of food in households. The report on the status of poverty by Stats SA (2016) indicated that in some households in rural areas people skip meals and reduce their food intake due to shortage of food.

According to Langba (2014) most households from poor communities depend on crops for their nutrients and due to the effects of climate change they find themselves struggling with reduced yield and crops with less nutrient value which affects their nutritional requirements. The study notes that there are certain types of food for different groups of people in society. For instance, elderly people prefer staple food and over cooked meals due to the fact that they no longer possess strong teeth to do the chewing. It is therefore necessary for them to buy processed food with all the nutrients they need.

Mandlene (2011) thinks climate change affects households in poor communities through shortage of clean water and sanitation. Without clean water, people are forced to share drinking water with animals. Then the rate of diseases such as cholera, malaria, chronic diarrhoea becomes very high and contributes to poor child morbidity and finally mortality. According to Madzwamuse (2012), the effects of climate change such as floods and droughts cause new patterns of pests and diseases that affect human health. During these extreme weather conditions, shortage of food and water affects sick people as they do not have access to food with nutrients value. People living with HIV/AIDS need more calories and more protein in their meal to sustain them, but with the shortage of crop yield in their communities they are likely to suffer more diseases due to hunger. This has shown that the availability and access to food are not enough; people need assurance on safe and nutritious food in order to be food secured.

2.5 FOOD INSECURITY COPING STRATEGIES

Household food insecurity results when food cannot be accessed with certainty in socially accepted manner (Hartwig et al, 2011). This means that when there is not enough and safe food. Maxwell et al, (2008) indicate that more households from rural poor communities rely on less preferred food, normally by borrowing or begging as a response to adverse events or shocks. Food security coping strategies are measures to strengthen resilience of households to food insecurity.

According to Parry et al, (2011), research has proved that even though South Africa is food secured at the national level, in rural areas household are still food insecure, and food insecure households have developed coping mechanisms to avoid living in hunger. Studies such as Maponya (2012), FAO, (2010), Ziervogel, (2009), have shown that South Africa's food insecurity coping strategies can be categorised into four dimensions, namely, consumption, income, migration and expenditure. It is important to understand these strategies to determine the depth of food insecurity for proper adaptation to the effects of climate change.

Consumption strategies include buying food on credit, reducing meals per day, restricting and reducing portions of food and including change of diet to cheaper food. Income coping strategies include the use of pensions to buy food, to start a small business in order to afford buying food and Sale of household or



livelihood assets such as chicken and livestock. Migration coping strategies include sending kids away to relatives or friends when food is not enough; and sending some members away to look for jobs elsewhere.

Expenditure coping strategy includes the use of savings to buy food, avoiding to get medical care to reduce expenses, or avoiding to take kids to school to save money for food. According to Maxwell et al (2008), these coping strategies are good for a short term period, but for a long term they are likely to push households into more poverty and hunger. The fact that the coping strategies are short lift shows that people are acutely food insecure. It is worth noting that most of the strategies used by poor people are unsustainable and likely to damage their livelihoods in the long run.

2.6 DETERMINANTS OF ADAPTIVE CAPACITY

Researchers have identified that there are determinants of adaptive capacity which could assist in deciding whether adaptation measures will succeed or not. It has been proven that commercial farmers have more capacity to adapt than small scale farmers. IPCC (2011) also recognises that poverty is also related to vulnerability, which means that financial power and strength determine the ability to adapt. Wlokas (2008) reiterates that in most cases, the rural communities are the ones who are most vulnerable to diseases, famine, conflicts, natural disasters etc. For instance, the small scale farmers in Limpopo Province of South Africa, are more vulnerable to the effects of climate change due to their low adaptation capacity, that is caused by their poverty levels (Maponya, 2012).

According to Ringer et al. (2011) the extent to which farmers adapt to climate change will be more influenced by their ability to access technology at different levels, and across all sectors. For instance, Brown (2009) suggests that warning systems, irrigation systems and flood control measures, are effective adaptation strategies that could benefit all sectors if implemented. However, issues such as poverty, low levels of education, lack of financial resources are such barriers in most vulnerable communities. Maponya (2012) also indicates that commercial farmers in most parts of South Africa are adapting well to climate change due to the use of technology than small scale farmers.

According to Thompson et al. (2010), it is very important for people to understand climate change so that it becomes easier for them to come up with adaptation strategies Orindi (2009) states that to interpret information about weather, people should have certain knowledge and skills, capacity building should be prioritised, to equip communities at all levels to participate in the course. When farmers are not well trained and skilled, it becomes difficult to effectively implement adaptation strategies. Lobell et al. (2008) also puts lack of education and advocacy to be a determinant of low capacity in most rural areas.

Orindi (2009) noted that in rural areas, good infrastructure has been threatened by extreme weather events in most developing countries. For instance, Limpopo in the Northern Province of South Africa, the heavy floods destroyed roads and electricity infrastructure that left one of the Province's tourist destinations

destroyed due to climate change. According to Maponya (2015), informal housing illegally built along the river banks in Alexandra, North of Johannesburg, were swept away by floods leaving casualties. The capacity of people living in these areas is very low and they need education in order to consider other options of adaptation such as migrating to areas that are not prone to natural disasters.

According to Madzwamusi (2010) most developing countries are countries characterised by abuse of democracy or lack of it and as a result they are mostly stuck with ineffective institutions of government that have less capacity to adapt to climate change. Studies have shown that most ineffective institutional arrangements are obstacles to adaptation. For instance, Sithole (2009) cited that the collapse of government institutions in Zimbabwe has made it impossible for the nation to adapt to any form of adaptation. Zimbabwe is vulnerable in food production, human settlement and resource distribution which present serious constraints that cause nonstop hardship to its people. Amusan (2015) discusses an example of corruption and skewed distribution of resources as causes of institutional deficiencies and threats to implementation of good adaptation strategies.

According to Sithole (2009), even though South Africa is a democratic country where there are good policies and strategies to adapt to climate change, financial policies do not favour vulnerable people who are in need of assistance, instead, wealthy people continuously become richer and more advantaged. Madzwamuse (2010) draws the conclusion that generally, institutions in developing countries lack capacity to manage climate change adaptation strategies.

Although there is considerable literature on what determines adaptive capacity of states, in many other studies have shown that adaptive capacity can be enhanced at different levels. For instance, UNDP (2013) suggests that good relationship and cooperation of developed and developing countries to establish and honour global and local priorities can bring more benefits than harm globally. As indicated by IPCC (2014), global adaptation research should be implemented through capacity building and funding to remove international obstacles to economic growth. When countries participate in climate change programmes globally, benefits go beyond financial gain, but also include technology transfer technical and other managerial skills transfers (World Bank, 2012).

Baer et al. (2009) emphasise that when climate change policies are prioritised by states through formation and implementation of adequate policies, effective government becomes the benefit, and more establishment of public support to adaptation at local and community levels becomes easy. To support that point, Madzwamuse (2010) indicates that at the local level all levels of society need to be represented in deciding on suitable adaptive measures.

It is highlighted that it is more important to encourage societies and local institutions to diversify their income sources in order for them to afford to adapt. IPCC (2011) confirms that when adaptation

measures, options and strategies are identified and prioritised by the locals, it becomes easier for the authorities to monitor and support with adequate financial support, policy and technology and knowledge.

2.7 POTENTIAL CLIMATE CHANGE ADAPTATIONS

In the literature where the dimensions of food security are affected by the impact of climate change, the adaptation strategies have also been proposed. Most researchers have used adaptation strategies and coping mechanisms somewhat differently, but in this study, they are not different, but just differentiated by wording. Therefore, this study uses the concept alternating. The same goes to the alternative use of the concepts climate change adaptation and adaptation. In the literature, some writers have tended not to coin climate change to the word adaptation therefore just terming it adaptation, whereas some literature has coined both terms to be climate change adaptation.

Adaptation has been defined by many other studies, however according to the Thompson et al. (2010), “Adaptation refers to actions that people take in response to or in anticipation of projected or actual changes in climate, either to reduce the adverse impacts or to take advantage of opportunities offered by such changes.”

When people are able to live in different countries with different environments, they are said to have adaptability abilities. Adaptability of people to the changing climate therefore is the trait that allows them to change according to the needs of their environment. However, they also need adaptive capacity to assist them to adapt effectively. In the IPCC, 3rd Report, it is clarified that determinants of adaptive capacity includes, the availability of resources and their distribution across the society. The society would also need the ability to implement innovative technological options and some skills and knowledge to pursue that. Equitable access to the resources, technology coupled with knowledge and skills would be more valuable in the adaptation of people to climate changes.

Most literature found positive and applicable adaptation strategies to reduce current food insecurity. According to the Bryant, (2009) Maponya (2012) and Mbilingi (2013), Adaptation to climate change impact can greatly reduce vulnerability by assisting rural communities to be able to adjust to potential damages of climate change and helping them cope with the adverse consequences. This is supported by Wlokas (2008) who states that rural communities can adapt but they are disadvantaged by their poverty, lack of resources and low education levels to assist them to be innovative and compatible to the new technology.

Globally, societies are already adapting to the impact of climate change. Farmers are moving from traditional agricultural practices to modern practices. Others are integrating the two to come up with effective responses. According to Orindi (2009), the impact of climate change has reduced the availability of water elsewhere including South Africa.

The study conducted by Maponya (2012) shows that farmers from Limpopo are using adaptation strategies such as water management, soil management and crop diversity. These strategies are backed by Brown, (2009); Mallikarjuna (2013) and Onyongo, (2011), that it is necessary to use irrigation to manage water in order to increase production. However, for small-scale farmers the irrigation system is expensive. There are also affordable measures such as building dams to harvest water for the dry season, or watering crops at night to ensure that moisture is kept in the soil longer in order to increase crop yield.

According to Balaghi et al. (2010), as the temperatures are rising and rainfall patterns become unreliable and unpredictable, farmers need to improve their land use according to agricultural suitability. Switching from one crop to climate resistant crop could assist in maintaining food security. Lobello et al. (2008) indicate that climate sensitive crops such as wheat could be replaced with lower water needs and high temperature tolerant crops such as sorghum.

On the other hand, Mbilingi (2013) states that personal and household socioeconomic position and access to resources are likely to affect adaptation measures. Farmers with financial power are likely to adapt with ease due to them affording all the resources including technology needed to respond to climate shocks. The indication is that poor farmers adapt for survival while their commercial counterparts adapt for profit.

The study by Ringler et al. (2011) on adaptation measures shows that when production has decreased due to the effects of climate change, farmers are likely to do crop diversification. They plant different crops in the same land to reduce the risk of yield failure. They also increase their chances of good yield to incase climatic conditions which favour them. This is important as it also promotes dietary diversity as required by food security.

2.8 THEORETICAL FRAMEWORK

Through constructive and critical theory, the study has assessed the key theories and approaches to assist small-scale farmers to adapt to climate change while dealing with food insecurity in rural communities.

2.8.1 Sen's Entitlement Theory

Climate change in this study is the main factor that reduces the ability of people to get food in any way. It is important to find out why there is still food ins that before Sen's theory, availability of food was the main determinant of food insecurity, however, Sen comes up with the concept that indicates that people can still exchange their entitlement to acquire food. This is also believed to assist farmers to think out of production and look at other sources of food apart from production (Vincent and Cull, 2009, Delgado, 2010, Patel, 2009,).

Sen's entitlement theory maintains that if people do not have entitlements to buy food, their food security is highly threatened. It emphasises that people need entitlements in the form of employment to afford to

buy food, assets to sell in order to buy food, some work to do in order to be compensated with food. This supports the fact that people need to have something of their own not only to be supplied with food.

According to Delgado (2010), it is important to note that increasing food availability is not enough to reduce hunger in the midst of climate change. Most people do not have access to enough food and therefore are food insecure. One of the reasons is that due to the effects of climate change, they are unable to acquire food through production, purchasing or exchanging something to get food.

It is important for this study to consider Sen's entitlement theory in dealing with the impact of climate change on food security, so that it clarifies how people could acquire food apart from producing food as well as determining which other sources of food are available. It is also likely to identify the gaps in the effects of climate change on other factors involved in food systems locally and nationally.

Sen (1981) clarifies that related to this theory of entitlement there are circumstances where the entitlements are unable to acquire food and that is called "entitlement failure" and this could happen when a person loses employment, where there is illness, political conflicts or price increase of food. For some people such as farmers, their entitlement are the food they produce, therefore when the production declines their entitlements fail.

The argument Sen (1981) puts across in this theory is that hunger is reduced by increasing the "food entitlement" over food of individuals, and is not based on how much food is in the markets, as this can be changed by policies, how food is secured, technology and change in an environment. This means that poor people are more vulnerable than wealthy ones, as the latter are likely not to have enough entitlements, hence their vulnerability to effects of climate change.

Delgado et al. (2010) expressed that because it is proven that climate change is certain to influence the entitlement over food for individuals, it is therefore important to have adaptation policies and strategies to protect those with little or no entitlements in order that they are also able to cope with the impact of changing climate on food security (Delgado et al. 2010).

Another dimension brought about by this theory is that there is a relationship in food access and the political power of households. This is supported by Patel (2009) indicating that politically, entitlements can be acquired through loans, aid, grants etc, and this may still depend on the political power the household belongs to. For instance, states are likely to influence entitlements only if the political powers allow it through policies and interventions. The position of South Africa is a clear example, where the vulnerable groups such as the pensioners, the disabled people and children are catered for through social welfare programmes.

This theory stands on the strength that it directs its attention away from conventional supply side of food crisis. It supports the notion that people should be assisted to make food not to be constantly supplied with food. Arguably, if South Africa, instead of concentrating on issuing child grants to youth, it has introduced education grants to youth to enable them to acquire their own money, in my opinion that would have created a different culture of educated society that is employed and be able to employ others. That would influence economic growth of rural communities and people would not have to migrate for job opportunities but would work in their local markets. The supply in this case would not be food but different ways of sourcing food.

On the other hand, Sewdie (2010), justifies this as important in considering vulnerable groups such as small-scale farmers that are directly affected by the impact of climate change because they heavily depend on agricultural production and income generation. This group is relevant in acquiring grants from the state in order to pursue their farming activities so that they can afford to produce and use their income to augment their food.

Sen's entitlement theory acknowledges that due to entitlement failures there is likely to be inequality in respect of entitlements and therefore advocates that those who do not have assets are more vulnerable because they do not have any other alternative of sourcing food, such as buying food, if their harvest fails. Supported by Frazer et al. (2011) in stating that food insecurity does not necessarily result from food supply but lack of purchasing power by the nation or household, it is the responsibility of government to ensure rural development that will enhance rural economic growth to provide households with purchasing power.

On one hand, World Bank (2015) indicates that food insecurity is purely economic disaster that needs technical and managerial solutions. In addition, the theory's implicated that food insecurity is a technical failure in economic system that can be solved by technologies and management of aid and development of industries.

In a way, the entitlement theory stands on the argument that food security is a complex phenomenon that is influenced by a number of factors. Zewdie (2014) further argues that the availability is influenced by factors such as a community's proximity to centres of production and supply, or by market forces, restrictions on trade and international policies that affect food supplies. All of these are fundamental to food-security analysis. Sen's work was nonetheless a great help to researchers on this issue as it enlightens that small-scale farmers' livelihood sources reflect their ability to acquire food.

Employing entitlement approach to this study is an acknowledgement that there is food insecurity in the rural areas. Income is not the only and not necessarily the most important instrument to access food. Given that income is hardly measured in rural areas of developing countries, a focus on entitlement is

preferable. Income reflects the short economic status of an individual or household, when assets provide more security on long-run wealth and vulnerability to food insecurity.

Even though Sen's entitlement theory has proved to be the appropriate theory for this study, it has its own restrictions. Of concern, it implies that when people fail to secure entitlement, failure in production leads to hunger and then to malnutrition, starvation and death. But research into people's responses to famine, often referred to as 'coping strategies', has shown that people's priorities in times of food stress are to preserve productive assets to protect livelihoods, rather than to meet immediate food needs (Corbett, 2014).

The theory is supported by the study; however, it does not seem to be taking issues of current importance such as the illegally acquired entitlement transfers. There is a bigger population of unemployed and whose unbecoming behaviours are claimed to be perpetuated by lack of access to food. This is a group of people who believe that they have been disadvantaged by the economic system and they prefer acquiring their entitlements in violent and desperate behaviours such as looting and raiding food markets. This has become a trend in South Africa that when people want to voice out their dissatisfaction about anything they resort to looting food shops. This is a clear indication that this theory does not consider extra legal entitlement transfers, or supply of food without assistance to acquire food. In other words, the theory does not support issuing of food parcels to the people as it is very short term and not sustainable, but instead people who are in a position to farm could be assisted with financial resources (grants), technological and management skills to produce food for themselves.

2.8.2 Food Systems Approach

In order for food security to occur, there are several activities that have to take place in order to come out with food security outcome. These food systems determine all dimensions of food security. In analysing food security, it is important to look at all steps from production to the end product.

According to Vincent and Cull (2009), food systems approach is made up of systematic activities starting first with producing food, which brings all active players such as farmers, pastoralists, fishermen, suppliers, labourers, and land owners together in order to ensure food production. With extreme weather events at play, food production is heavily affected.

Secondly, food processing entails preparation of raw food into food products before sending them away to retailers. Grains such as maize are processed into mealie meal, cereals, etc. Thirdly, food packaging and distribution which includes transporting of food from one place to another; it is important that the food is protected to maintain its freshness to reduce risks of decay or expiry dates. Some food lose their freshness through being stored in high temperature areas, they need cooler storage to keep them fresh. This is the middle man activity between producers, processors, packers and the market.

The last activity is to send the food to retailers and consumers. This is the point where one needs money or an entitlement in order to access food. Like Sen (1981) indicated, if one does not produce one's food, one should have entitlement to purchase one's food. Food systems approach shows clearly the interactions and relationships as well as dependencies when food security is addressed. All activities are interrelated and they are bound to work together to ensure food security (Story et al. 2009).

In the presence of climate change and its impact, it is crucial to ensure better health outcomes through the food chain. Climate change affects all stages of food systems. Due to climate change, when yield is decreased at the production stage, processors are likely to augment and add other food in order to ensure the quantity and come out with a different quality of product with reduced nutrients but increased flavours just to keep it in the market. The packaging is often made in such a way as promoting the product to ensure that it stays in the market, at the end, consumers are left with no option but to buy. This is the result of the new generation of chronic diseases due to reduced nutritional food on the market as a result of affected food systems (Lobell et al. 2011).

This approach promotes healthy diets that are local and feasible to local consumers. The system brings together agriculture, food and health. Climate change, trade agreements, world food prices are likely to affect foreign food systems (Erickson et al. 2011). According to Ingrams (2009), land rights, local markets policies, and natural degradations are likely to affect the resilience of local systems. Food systems approach helps to identify where the vulnerability lies in the system and identify coping options. It serves as an effective checklist for planners and policy implementers to ensure outcomes of food systems in order to come up with adequate, appropriate adaptations to the effects of climate change.

This is the approach taken by the Global Environmental Change and Food Systems (GECFS) Project during their investigation on the vulnerability of human food systems to its interactions with environmental change. It has also been used to analyze how food systems are affected by global environmental change, in order to identify adaptation options and possible adaptation strategies on socio-economic and environmental conditions (Ingram, 2011).

After investigation on the relations between two major global processes influencing vulnerability in climate change era, O'Brien (2008) discovered that yes there will be losers and winners. Small-scale farmers are more vulnerable than commercial farmers, therefore will lose from both climate change and economic liberalization. However commercial farmers because of their financial situations will win from both processes.

Another similar research was also done on UNRAVEL (Understanding Resilient Vulnerable Livelihood) project in South Africa, Malawi and Zambia, to investigate the role of multiple stresses on the vulnerability of food security. It was found that poverty is a big cause of food insecurity. South Africa was

found to be different because small percentage of the population relies on agriculture for their livelihood, and another advantage is that the state provides social grants to part of its citizens (Ziervogel et al. 2006).

However, in critically assessing the food systems approach, one finds that ultimately, food security is a principal outcome of any given food system. It advances that even if the food chain is successful, in many cases, food security is not achieved; instead, people are undernourished and face regular hungry seasons, or struggle with a host of non-communicable diet-related diseases, or spend the major portion of their income on poor or inadequate diets. This is because even when food systems have made food available, not everybody affords to buy preferred healthy food. It supports the previous theories that people need purchasing power in order to access food. With food systems approach, it is proven that although it is a major outcome for food security, food security is not always achieved (Amir, 2013 Ingram, 2011).

This study therefore adopts this approach to analyze food systematic chain in order to recognize factors that influence food insecurity. Ingram (2011) found out that even though climate change is a major stress to food security, other stresses like conflict, HIV/AIDS and poor governance influence vulnerability to poor communities. For example, when truck organisations decide to go on strike, the whole food system is affected by the strike, as food cannot be delivered to different areas, manufacturers of other supporting utensils such as the packaging stuff are not able to transport them to different clients areas as a result, the whole food chain is affected.

2.8.3 Household Economic Approach (HEA)

Other approaches like The Household Economy Approach (HEA) and Sustainable Livelihoods Approaches (SLA) are extremely complementary to the Food Systems Approach, with HEA offering the opportunity of quantifying need (Save the Children, 2005).

Household Economy Approach is a method that is used to assess the vulnerability of rural population to economic shocks and changes in their livelihood patterns and market information. It is used by many governments to detect early warning for food insecurity in societies. According to Lobell et al. (2011), communities are demarcated into rural livelihood zones according to how they use their land, climate, rainfall, markets and this information is scored on whether it was good or bad for a year. This is done through focus groups and interviews with villagers to establish the income and expenditure levels. The information gathered is used to detect the impact of economic shocks or changes on how the communities access food and other basic needs for households.

There is a clear relationship with Sen's entitlement theory to create a detailed social and economic data to show the impact of production and other shocks on household income and food access. Entitlement theory explains a person or household ability to get income, food and other necessities through the use of

their land, livestock, labour and other productive capital. This is done within the legal framework, conditions of production prices and customary rights.

The approach supports government's early warning system by providing a way to better analyse information about emergency responses. Through this model, studies have found out that poor households in the livelihood zone are not only affected by price increase of staple food but they are also affected by climate change and other environmental changes (Frazer, 2011).

Although it has been used by many organizations as an analytical tool that ordinarily examines elements such as the "Sustainable Livelihoods Framework," it places a greater emphasis on quantifying the outcomes of livelihood strategies pursued by different households and livelihood groups (Ziervogel, 2010).

The household economic approach is very crucial for the study in order to assist the study to identify factors about households that bring inequality to vulnerability on food security. The approach should assist the study to understand better how people make ends meet, how do they cope, which is critical for assessing how livelihoods will be affected by climate change and for planning interventions thereof (Patel, 2009).

2.8.4 Sustainable Livelihood Approach

Flowing from the information gathered through household economic framework, Sustainable livelihoods approach is added to include wider dimensions such as human, social, natural, physical and financial aspects of livelihood. According to Fraser et al (2011), food security can be sustainable when people have access to diverse livelihood resources. The sustainable livelihood resources include (a) human capital – health, knowledge, skills, information and ability to work. (b) social capital – relationships of trust, membership in groups, and networks. (c) natural capital – land, water, biodiversity, and environmental resources. (d) physical capital – water, energy, transport, communications, equipment and housing. (e) financial capital – regular remittances, pensions, grants, savings, and supply of credit. Through livelihood approach, livelihoods are understood well and how they are likely to be affected by changes and shocks, whether people will be able to cope and adapt to the situation. It also suggests steps that could be taken to reduce vulnerability.

According to Morton (2007), food security can also be achieved by importing food from outside the livelihood, and strengthens the argument that government support is very key in livelihood sustainability. Government has a responsibility to enhance household capabilities and assets through provision of employment, education, and health. However, Vincent and Cull (2009) also expresses that not only government is responsible but non-governmental organisations and private agencies have a role to play in livelihoods.

The study adopts this approach on the strength that it makes the argument of the study clear on the vulnerability of rural communities to food security due to their lack of capacity to adapt to effects of climate change. As already supported by household economic approach, without rural development, which enhances the food chain as introduced by food systems approach, it is difficult for rural communities to enjoy sustainable food production, as they are affected by poverty, underdevelopment, unemployment, lack of education and so on. Understanding livelihoods and resources that need to be availed in order to equip livelihoods against shocks and climate change is very crucial for this study.

2.8.5 Food sovereignty Approach

Food sovereignty is described by Patel (2000) as the right of people (a) to define their own food and agriculture, (b) to protect and regulate domestic agricultural production and trade in order to achieve sustainable development objectives; (c) to determine the extent to which they want to be self-reliant; (d) to restrict the dumping of products in their market; (e) and to provide local agriculture based communities the priority in managing the use of and the right to land and its resources.

According to Toledo (2011), this approach promotes the formulation of appropriate trade policies and practices that give people rights to food, safe, healthy and ecologically sustainable production. It is further indicated that the approach favours rural marginalised communities in addressing two things. Firstly, popular grabbing of land and monopoly on food production and market chain by few transnational corporations undermine the local communities capacity for autonomy self determination.

Secondly, organisations such as the World Bank and the Gates Foundation that come with the agenda of modern developments in order to reduce poverty by decreasing the number of local food producers and instead encourage them to get employment in urban areas, leaving their rural areas underdeveloped and growing the economy of already developed urban areas.

According to this approach, food security is achieved when more small-scale farmers have acquired land and sovereignty right to select the fertile, cultivate, consume, exchange and trade their own crop yield. This means that there needs to be capacity building for farmers as they are required to be a strong hold on food production and supply chain through legal and democratic rights on the control of land, ecology and market (Patel, 2009; Wittman, 2011).

The approach puts more emphasis on the local nutritious and culturally preferred food production chain where people do not find themselves having to depend on the market for food. This approach is more favourable to local small-scale farmers as they have an opportunity to produce own local food preferred by both producers and consumers. Imagine local market where a Xhosa man in mining area of Rustenburg would just walk into a restaurant and be able to order his Xhosa cusien and eat preferred food than having to struggle with names of native American food in the menu of some local Spur restaurant.

This approach supports a fair trade market and consumer culture that is supported by local food instead of genetically modified food from somewhere else.

Food sovereign approach seeks (a) to strengthen more sustainable and self-reliant food producers, (b) to ensure that the access to food as a democratic right is achieved, (c) implementation of the rights of rural communities in particular farmers to land and other natural resources such as water, (d) to promote freedom of food and livelihood options, (e) to mainstream gender equality in government programmes, and (f) to intergrate indegenous knowledge as a necessary condition for genuine food security in rural communities (Pimbert, 2009).

This study adopts this approach on the strength that in understanding how small-scale farmers have been coping with climate change, it may be crucial to determine whether the small-scale farmers are enjoying their right to use the land and other natural resources, such as water. For instance in some villages in the North West Province of South Africa, communities around mining areas are often in conflict with mining companies that occupy their land and use more water in their mining and leave communities with shortage of clean water.

The study also wants to establish the role played by government in assisting small-scale farmers in dealing with climate change shocks. It is therefore important that according to food sovereignty approach, the study determines whether government promotes freedom of food and livelihood options to vulnerable small-scale farmers whose entitlements have proved to have failed, or ordinary rural community households that are poverty stricken.

This approach is also adopted on the strengh that assists the study to evaluate government's mainsteaming of gender equality in as far as access to food is concerned. For instance, in most rural communities women are the ones providing for their families with food, and most of them are single mothers who are breadwinners, it would be crucial for the study to evaluate the extent of assistance that government is giving to this group and other vulnerable groups positioning them to cope with the effects of climate change.

2.8.6 Integral Theory

There is evidence that among the philosophies of climate change lays the integral theory. According to O'Brien (2010), this theory offers a framework that takes into account the occurrence of the changing climate in a broader way. It is very important to use integral theory for responding to climate change because it recognizes the interior and exterior dimensions of climate change and of climate change research (O'Brien, 2010).

According to integral theory, it is essential to recognize that responses to climate change may also affect human development. One person or group's adaptation to climate change may increase the vulnerability of others. For instance, when a commercial farmer installs a high power irrigation system in his area, some may feel that due to lack of water availability in the area, his system is responsible for their shortage of water. It is also clear that the effects of climate change may generate further challenges in meeting the Millennium Development Goals, particularly if climate variability and extreme events increase (O'Brien; 2010 Lobell, 2009).

It is important to acknowledge that integral theory responds to climate change and it is influenced by various factors such as political, social, economic, and geographical factors, among others. There is no single cross-cutting solution to climate change, and it is unlikely that a single solution will be found, therefore, the theory acknowledges that new technologies and innovations may take years to develop, and they may create new risks and problems especially for the impoverished (O'Brien, 2010).

The study wants to understand the impact of climate change to food security. It is therefore crucial for the study to understand climate change and its dynamics in order to devise some means to manage it. The study looks at the effects of climate change on food security holistically, identifies possible appropriate adaptation strategies, which means that integral theory is very crucial in assisting the study to identify the elements of climate change that influence how small-scale farmers should respond to the risks of climate change. The study therefore adopts this approach as well.

2.9 RELATIONSHIP AMONGST PROPOSED THEORIES AND APPROACHES

According to Mark et al (2007), it is acceptable to use different theories that deal with similar issues especially in the social science arena where theories are used to understand real life situations. It is therefore against this background that the study adopts different, and yet related theories in terms of what the study wants to achieve. Theories and approaches adopted in this study have proved to be consistent with issues relating to the study. The confidence of the study in the theories is borne by the fact that the theories are constructed by systematically collected data and carefully analysed data to identify different patterns.

This section therefore articulates the relationship of these theories and approaches. Sen's entitlement theory suggests the use of entitlements and other alternatives as sources of food other than concentrating on production of food only for survival, which is also highlighted by the integral theory to consider the likelihood that the impact of climate change can affect both supply and sources of food.

This consideration interacts directly with the distribution and reproduction of entitlements to food, which is determined by sustainable livelihood systems in local economy. It is also important to note that this entitlement-based approach to climate change accounts differently to different groups of households on

food production. For instance, climate change impact on farmers production based entitlement affects their access to food and the poor farmers who are without diversified livelihoods and few assets buffers, are likely to suffer food insecurity due to lack of alternative sources of food (Vincent and Cull, 2009).

One dimension as stated by Sen's Entitlement theory, is the emphasis that it sometimes happens that entitlements fail and entitlement failures lead to hunger, starvation and death therefore sustainable livelihood approach should be considered to determine livelihood resources and how they can be used to cope with the situation.

In his studies on responses to famine and food insecurity, Corbett (1988), indicates that people often respond through their own means and when they are in distress they do not always resort to exchanging their entitlement, but they protect them in order to preserve their livelihood as echoed in sustainable livelihood approach. Sovereignty approach highlights people's rights to determine what they want about their food, land, trade and market, which could be of great assistance to the study.

Because Sen's Entitlement theory has identified that food insecurity affects more households that lack buying power or power to produce food. Livelihood approach also supports but indicates that food security can be sustained when people are educated, healthy and have employment, as that together with their development in their livelihood would determine the type of responses they need to apply.

This also goes hand in hand with the household economic approach where responses to food shocks rely whether a household has any form of economic power to respond. It is also supported by sovereignty approach that people can decide their own way of increasing their own buying power using their rights to food security. It is also necessary to evaluate the contribution of the food systems approach supported by household economic approach and sustainable livelihood approach to determine the value of entitlements as to whether they need to be improved or diversified by other means. All approaches are complementary in quantifying the needs of household in an effort to curb food insecurity.

The relationship between the household income as entitlement is advocated by Sen's entitlement theory and sovereignty approach comes forward to indicate where the income will be invested, whether in the local agricultural market or in foreign investments in the market. The study should direct the discussion in terms of the two approaches on what should happen if the impact of climate on agricultural activities leads farmers to decide to opt out of the agricultural sector and leave their villages for off-farm employment, how will that impact on rural labour landscape and labour costs associated with overall performance of their agricultural sector.

The two approaches should also be able to guide the study on whether indigenous agricultural knowledge would still be transmitted into the modern agrarian landscape if small scale farmers leave farming for other jobs. The study would also be interesting if the position of the remaining farmers who want to

sustain their production in the midst of climate change even when modernisation and industrialisation have diluted their livelihood systems, and market turned more powerful than their small scale farming, whether they will still stay.

Another interesting relationship comes from the integral theory as a framework that takes care of climate change occurrences with the rest of the approaches. In every food system, from the production of food to consumption of food, climate change is likely to threaten food security, therefore it is important to be aware through food systems approach that there is the likelihood of improvements in the food systems that may not necessarily be favourable to the impoverished societies. This may include technologies and innovations to utilize adaptation systems. This simply means that a proper planning in terms of sustainable livelihood, household economic approach should be of assistance in coming up with well quantified outcomes of livelihood so that societal commitment and participation in identifying appropriate adaptation strategies can be strengthened by reliable and appropriate households and their livelihood profiles.

Lastly, the study adopts all theories and approaches on the strength that they are interrelated more specially in clearing the pathway through the impact of climate change to attainment of food security by small scale farmers.

2.10 SUMMARY

Despite being a relatively new research field, a lot of work has been done to try to explain climate change, food security and climate change adaptations. As indicated in the discussions throughout the chapter, despite the differences in different definitions and contexts, research confirms the impact of climate change to food security. All point out to adaptation as a key factor in reducing the vulnerability of communities to the effects of climate change.

This chapter presents the climate change and its impact on food security. It expresses that climate change is caused by emission of greenhouse gases, which are partly contributed by agriculture through fertilization, deforestation and other land use. It is also noted that climate change affects food security through rising temperatures, precipitation, and extreme weather events, which (a) shorten growing seasons, (b) decrease yield, (c) reduce amount of arable land and pastoral land, (d) shortage of water. This section also touches on the effects of climate change on food security through its dimensions namely, food availability, food accessibility and food utilization. The three dimensions are discussed together with their adaptation systems.

The chapter also looked at the coping mechanism used by small-scale farmers to avoid food security. Rural communities use coping strategies such as (a) Consumption mechanism – buying food, borrowing money, reducing food intake etc., (b) Expenditure mechanism – use of savings, avoiding paying for health

care, and avoiding education in order to acquire food, (c) Income mechanism – use of pensions, small business, sell household goods or livelihood assets, (d) migration – sending kids to relatives or going to look for work. These mechanisms are not long-term so rural communities need assistance from government and private sector to adapt for longer periods.

In this chapter the determinants that could be used to guide a decision on appropriate adaptation strategy were also discussed as follows, (a) ability to access technology, (b) levels of education, (c) good infrastructure, (d) capacity building, (e) effective institutions of government and, (f) good policies to support adaptations. The study uses the concepts adaptation strategies and adaptations; coping mechanisms and climate change adaptations are used interchangeably. Adaptations are explained and their importance clearly defined. Identified common adaptations include, (a) water management, (b) soil management, (c) crop diversification, (d) and livelihood diversification.

This chapter also discussed the available theories relevant to the study. Although other theories and approaches were discussed, the study found that there is a clear relationship in all the theories. Sen's entitlement theory is discussed as the main theory that gave rise to the rest of approaches in an effort to understand what causes food insecurity as the suitable theory for looking at the impact of climate change on food security.

The chapter discussed the importance of the following theories and approaches and how they relate to each other in coming out with effective adaptation strategies, (a) Sen's Entitlement Theory, (b) Food Systems Approach, (c) Household Economic Approach, (d) Sustainable Livelihood Approach, (e) Integral Theory. The study adopts all the theories and approaches as they have a common understanding of the need to alleviate food insecurity in the midst of all other natural disasters, political, cultural and environmental issues. They all agree that food security can be sustained through effective adaptation strategies.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter explains the researcher's decision on the type of research method to use in the study. The study is based on understanding some social aspect of social life, which can be generated in words not numbers, therefore the study adopts qualitative research method. To make it easier for the type of questions asked in the study, the qualitative method has proved to be the appropriate choice in answering the questions, "what", "how," and "why" (Mason, 2010). Because the aim of the study is to understand how a small-scale farmers in Limpopo and North West Provinces adapt to climate change, the qualitative method is appropriate.

3.2 Qualitative Research Method

The study adopts a qualitative research methodology. It maybe comforting to learn that there is no single acceptable way of conducting a qualitative research, as it is determined by range of issues that includes; the nature of the society, what can be learnt about it, the purpose of the research, its goals, the classification of research participants, beneficiaries of the research, even the position and environment of the researchers themselves. According to Strauss (2011), when research produces findings that are not reached through statistical procedures or other means of quantification, they can be considered as qualitative research; it is also important that such should be a research about persons' lives, lived experiences, behaviours, emotions, and feelings as well as about organizational functioning, social movement, cultural phenomena, and interactions between nations.

Qualitative research views social life as a process not an event, therefore it is a flexible strategy that involves close contact between the researcher and the participants. This is normally done through the interviews, focus groups, observations and analysis of other texts and documents. This method allows the researcher to purposively select a small sample of participants that meet the requirements. Due to its interactive nature, data that is more detailed and extensive is collected, and it therefore allows for follow-up in areas that are not clear to the researcher. Even the type of questions asked require explanation or understanding of a social environment; and are suited to study processes that occur over time (Hancock, 2009)

However, there are instances where the research question explores questions that asks *how many*, *how much* and *how often* something happens. For such questions it is advisable to use qualitative reseach. This helps the researcher to broaden the scope of understanding how things unfolds in a social world. On the other hand quantitative research method emphasizes the objective measurments, statistical mathematical

and numerical analysis of data collection through questionnaires, polls, surveys or manipulating pre-existing statistical data. Its focus is entirely on gathering numerical data and generalizing it across groups of people or to explain a particular phenomenon. (Babbie, 2010).

Contrary to the qualitative research, quantitative research method helps the researcher to determine the relationship between variables within a population. It either uses a descriptive or experimental method. Its focus is on numeric and unchanging data. Unlike the qualitative research method, quantitative method is characterised by data that is gathered through structured research instruments, whose results are based on a larger sample sizes representative of the population. The researcher normally has a clearly defined research question to which objective answers are sought. Tools such as questionnaires or computer softwares are used to collect numerical data. The aim of quantitative research is to classify features, count them and construct statistical models to explain what is observed. The questions asked in this study did not necessarily require statistical data (Ritchie, 2009)

Comparatively, definition of a qualitative research supports a researcher's decision for this study. Qualitative research in this study is adopted to shed light on how small-scale farmers adapt to impact of climate change. The research questions involve exploring how people experience climate change and how they cope with food security in the midst of climate change and its impact. The study further explores the view of people in the new era, where climate change is not yet understood by many. A major strength of the qualitative methodology on this study is that it allows for enquiry on the behaviour of people, how they are affected by the existing events that go on around them; and finally recommend some strategies for them to adapt.

Qualitative method was chosen for this study because it suits a liberal approach to research, that allows for flexibility when conducting a research. However there are criticisms levelled at qualitative research. Cheek (2008), claims that the results of the study may not be generalizable to a larger population because of the size of the group, intention of the study is not to have a large population of samples. In deciding on a qualitative approach, this study looked for a method that would allow a researcher to determine how participants interpret, construct, and ensure that data are collected in a naturalistic setting in the comfort of the subjects. Creswell (2008), also advanced that qualitative methods are especially responsive to local situations, conditions and stakeholder needs.

3.3. Research Design

The research design describes how the researcher approached the study. This part of the methodology explains where, when, who, what and how will the research data be collected and analysed. The study considers few qualitative research designs. In order to understand the environment of the participants in the research, the researcher had to do a biographical study of both provinces through Statistics South

Africa reports, in order to get a feel of the participants' perspectives. Profiles of both provinces and other documentation about the provinces were consulted in order for the researcher to understand the social world in both provinces.

Understanding of individuals and group experiences were helpful for the researcher when conducting this research. The perceptions, reactions, and feelings of the participants as they experienced the events of the changing climate were important as they gave the researcher an understanding of the events beyond purely quantitative details. The fact that the researcher interviewed small-scale farmers, and government officials deployed to assist the farmers, gave the researcher an opportunity to look at the issues, from their individual's point of view.

At some point the researcher had to use ethnography as a method of qualitative design. To be part of the culture of small-scale farmers in order to see their culture through the eyes of small scale farmers. When participants talk about shortage of water in their area and willing to show the effects of rising temperatures and lack of rainfall and their impacts in their area, it becomes easier for the researcher to understand their perspective in answering the questions.

As part of the researcher's work to interact with small-scale farmers, the researcher had an opportunity to live in the rural areas of both provinces. The researcher has family in Mokopane, Limpopo, where she visits on weekend basis for the past ten years. One of the devastating experience there was the lack of water for more than three days and people had to buy water. The most worrying factor about this experience was that one could see that even though the Local Municipality was providing people with water, the water was not always clean and not enough. Out of this experience one could identify the very poor people who could not afford to buy water or food, who would be helpless when the water truck was delayed or could not come.

Due to high temperatures and drought, shortage of food in the area was evident in 2014/2015. One would struggle to get variety of affordable vegetables from the street vendors. The vendors were also reluctant to buy more stock due to the fact that they did not have enough storage to keep their vegetables in the hot temperature, they purchased small stock that could be sold before they get rotten.

Due to poverty, some villagers continue to use paraffin, wood and cow dung to cook even though they have access to electricity. Their reason has been that electricity is expensive, so they rather spare money to buy food not electricity.

3.3.1 Study area

The Study areas are Limpopo and North West Provinces of South Africa. Compared to other Provinces in South Africa, the researcher decided on the two because of their unique features as rural provinces and

their history of farming. Limpopo Province has a population of 5.4 million people and is 90% rural. The poverty level is at 12.6 % . About 68.3% of farmers are small-scale farmers farming in livestock. Crop production is at 32.2% and fruit production at 44.8%. (StatsSA, 2011).

North West Province has a population of 3.5 million people and is 64% rural. Poverty level is at 8.2%. About 9.% are livestock farmers. Crop production is at 11.3 and fruit production at 11.4%. (StatsSA, 2011). Agriculture remains key to food security in these province and this makes them to be more sensitive to climate and related variables and how this impacts on food production and food security.

Limpopo has parts that are semi-arid on the west and the eastern parts that are tropical. Although it falls in the summer rainfall, the north and western parts are very dry. (Maponya, 2014). North West's eastern parts are much wetter and the western parts drier and hotter. The low level of rainfall exacerbate droughts during dry seanson. The eastern parts receives more than 600mm per annum while arid areas receive only 300mm of rain per annum. They are both dry and very hot in summer.

Climate change is said to be a global threat (IPPC, 2014). The researcher therefore wants to examine whether the impact of climate change can also be tested on domestic perspectives in South Africa. The study was conducted between 2015 and 2017, during which periods both provinces experienced extreme weather events (rising temperatures, drought, floods, precipitation etc) caused by climate change. In 2015, early November, Limpopo and North West Provinces were among provinces where temperatures were recorded as high as 48⁰C. During this time there was prolonged heatwave, coupled with high temperatures and drought. There was also lack of rainfall that was blamed on El Nino effect (DAFF, 2016).

3.3.2 Population and sampling

While there is no consensus on the size of the sample for qualitative research, it is well agreeable that, one just needs an occurrence of a piece of data or a code, to ensure that it becomes part of the analysis framework. Mason (2010), admits that fifteen (15) is the smallest acceptable sample. Creswell (2011), suggests that twenty five (25) is the adequate size depending on the project, and still Thorogood (2009), maintains that a good qualitative sample often remains under fifty (50), and his experience with interviews in this method is that one only gets to the gist of issues after interviewing twenty people, otherwise more is often a repetition of the issues.

Driven by conclusions of Hancock, 2009; Mason, 2010 and Ritchie, 2009, on the qualitative method, research questions and their purpose, the time frame for the study and reasonable resources available, the study followed Purposive Random Sampling. This qualitative procedure assisted the researcher to reach the targeted sample quickly. Although there may be more small-scale farmers in the Province than one can handle, the procedure made it easy for the researcher to get a sample of subjects with the specific characteristics needed.

The researcher was able to select subjects that are knowledgeable about the research issues based on their own experiences. Small-scale farmers are made up of men and women and youth, as a result the selection criteria was such that all the groups had to be represented. They had to be between the ages of eighteen and sixty five. In purposive sampling, data collected are very informative for the research; moreover, this study only used a small sample size and ensured that it produces credible results. The researcher is also aware that the samples may not represent the entire population and that would limit the generalization of the findings. However, convincingly the study adopted the procedure, that is, purposive sampling.

The population of small-scale farmers used was inclusive of men, women, youth, who for the purpose of this study they were all considered just small-scale farmers. Fifteen (15) small-scale farmers from Limpopo were divided into ten (10) females and five (5) males. From North West Province twenty (20) small-scale farmers were divided into fifteen (15) females and five (5) males. The number of small-scale farmers from North West was more than the ones from Limpopo, because the researcher resides in the Province, therefore it was easier for her to get more sources. It is also a fact that small-scale farmers in rural areas are mostly consist of women, therefore the number of female small-scale farmers was more than the male small-scale farmers in this study.

3.4 Data Collection Methods

Data collection is the process by which the researcher collects information needed to answer research problems (Mason, 2010). Focus groups of ten to fifteen farmers were used as an initial stage to raise and begin to explore relevant issues which will then be taken forward through in-depth interviews. The strategy worked really well for the researcher in Limpopo in particular, where the issues were unfamiliar and the researcher had to identify issues for coverage during interviews.

The focus groups included small-scale farmers, government officials, and other stakeholders in climate change and food security fields, to supplement small-scale farmer's views. This was the researcher's effective way of digging out the cultural norms and understanding issues of concern within the group. This shed more light on coping mechanisms used by the communities.

The Interview was also conducted with two (2) Government Officials from the Department of Agriculture in each of the Provinces, two (2) Government Officials from the Department of Environment from each of the Province, One (1) Official from the National Department of Agriculture, Forestry and Fisheries and; One (1) Official from the Department of Environmental Affairs. In total a sample of forty five (45) sources was purposefully selected for the study.

As explained by Teddie and Yu (2007), purposive sampling is effective for selecting individuals, groups of individuals, institutions, according to specific purposes related to answering the research questions. It

is justified in this study as it allowed the researcher to exercise the biasness in an attempt to sourcing reliable and robust data. It also allowed for easy selection of those accessible and keen to participate.

In search of the appropriate data collection instruments, the researcher had to consult academic journals to learn what kind of instruments are being used in similar studies. The researcher also read some books that provides information on available choices of instruments. Unstructured questions was used to elicit information during the interviews. Although the interviews were unstructured, the set of questions were helpful to remind the researcher the structure of questions designed for the study. Another tool used in the study was unstructured interview, which allowed the researcher flexibility in questioning the subjects.

The study used unstructured questions on the impact of climate change on rural communities' food security. The interviews are intended to be as flexible as possible to permit all topics to be covered, explored and probed. This is a conversation with a purpose between the interviewer and interviewee. Primary data was collected through unstructured and semi-structured questions, and where necessary the interviews were recorded and transcribed.

The interviews were conducted with selected respondents in English, Setswana and Sepedi. This allowed the researcher a chance to determine issues on the impact of climate change, how the respondents understood climate change, their coping strategies, their access to food and food production, and how they have been affected, and whether they received any assistance from government or any private company. The benefits of in-depth interview in this study were that the responses from the subjects were assured and usable, clarification was provided where necessary, and no items were overlooked.

The study adopted unstructured and semi-structured interviews. According to Ritchie (2009), the main qualitative research instruments include, direct observation, in-depth individual interviews, focus groups, and analysis of documents and texts. It is a familiar, flexible way of asking people about their opinions and experiences. One attraction to interviews was that one could generate a considerable amount of data from the interview.

A set of key questions which explores the impact of climate change on small-scale farming community as a whole was used. The selected purposive sample had prior knowledge of the effects of climate change and able to provide information on behalf of the farming community. Data from these interviews were later combined and analyzed.

Since the researcher conducted the interviews alone, it was best to prepare and follow an open-ended question plan for the semi-structured interviews. In some instances she had to record the interview, as it was not easy for her to focus on conducting the interview and jotting down the notes. Because the researcher has acquired enough understanding of her topic, this allowed her some space to learn and understand the culture and experiences of locals on the same subject.

The Farmers Day, was a discussion group where farmers with similar background, whose experience of climate disasters is likely similar come together in an informative session with government employees and other relevant stakeholders. Their discussion with the Government Extension Officers on impacts of climate change enabled analysis and understanding on the selected group topic. For instance, the topic on Climate change and livestock production was used to understand the impact of drought or floods on their production.

The importance of the focus group in this study was to collect data generated by interactions between group participants, where they presented their own views and experiences, but also have a chance to listen and reflect on what is being discussed and then come up with their own experiences.

Secondary sources used throughout the study were academic journals, database sources, reports from agricultural research centres, published research studies, and relevant books.

3.5 Fieldwork Experiences

One of the lessons learned during the data collection exercise is patience and sensitivity. Even though participants had agreed to participate in the research, I sometimes had to change the arrangements because they had to change their plans to attend to other important issues. It was also important for the researcher to be clear about how the findings on the research will be used, especially the anonymity and confidentiality of the responses.

In most visits, the participants started the interview very rigid and unwilling to talk about some issues, but as the discussion progresses, they became very comfortable and divulge more information, and this gave the researcher an opportunity to repeat the questions to ensure that the participant is comfortable with the responses he or she had provided.

The researcher also attests that co-operation is likely to be easier when the participant is familiar with the subject matter and is able to show his or her knowledge of the subject, including relating to local experiences. Even though the participants were emotional around some questions on the assistance by government, they all accepted the fact that with the recommendations they propose, with time the situation will change, and this gave them hope.

No major challenges can be recorded during the fieldwork, infact the participants were appreciative of the researcher's small tokens of appreciation for their assistance, time and thought they have provided to the study. As the researcher had studied the different cultures before attending meetings with subjects, the cultural background, in some instances had to be adhered to. In one focus group, where the chief was part of the meeting, the researcher had to ensure that she dresses in a culturally acceptable way.

Even though the study was conducted in two different provinces with different cultures, The language barrier was never experienced, in most meetings the researcher used the language that the participants were more comfortable, which was never a challenge for the researcher.

3.6 Data Analysis

Analyzing data in a research project involves summarizing the mass of data collected and presenting results in a way that articulates the most important features of the research. According to Hancock et al., (2009), qualitative data analysis is when the researcher makes sense of participants' responses, their views and opinions. Cohen et al, 2009, also points out that qualitative data analysis is transforming collected data, into understandable information. All approaches have their own different types of analysis and this study adopted interpretational analysis of the data collected via thematic approach.

Data was classified into field notes, interview scripts and all recorded observations. Data collected through unstructured interviews is generally very voluminous. The first step was to number all questions. The questions were corrected and completed. The language was then converted to English for easy processing. According to Calvert (2009), interpretational analysis is important for the researcher to organize data, documents and field notes. The researcher then grouped the comments by themes, topics or categories in order to focus on one area at a time.

Data was categorised in numbers, and codes were written in each questionnaire next to the responses. Similar responses were given the similar codes. Different codes were developed for each question. After coding the analysis was done manually and data master sheet was developed to organise data. It has various coded responses on the questionnaire, to make it easier to tally responses by hand. After organising data on the master sheet, it becomes easier write totals for individual variables.

Data was then captured into the computer in their coded form, if there are mistakes they are easily corrected. Then data was analysed and the needed results recorded and presented.

3.7 Research Ethics

There are several reasons why it is important to adhere to ethical norms in research and this study is not an exception. Ethics in research promotes prohibitions against fabrication and falsifying or misrepresenting facts. It also promotes values essential to collaborative work and protect intellectual property. The researcher also has to be accountable to the public by promoting moral and social values. Ethical clearance was sought from the University by the researcher. The study observed all ethical codes and assurance of confidentiality was given to participants.

3.8 Conclusions

The chapter outlined how the research was carried out. The study adopted qualitative research method, which is appropriate for the study. The research design explained where, when and how the research data was collected. The study areas were also described in terms of their features and annual temperatures. The population and sampling of the study were also outlined. Purposive random sampling was followed, where interviews with individuals and focus group discussions were conducted as a way of collecting data. The researcher outlined the fieldwork experiences during the collection of data. Collected data through unstructured interviews was analysed and results recorded.

CHAPTER FOUR

CLIMATE CHANGE AND ITS IMPACT ON DEVELOPING STATES

4.1 INTRODUCTION

This chapter highlights the impact of climate change in developing countries with an emphasis on African countries. It first explains the history and background of climate change in Africa, its effects and the experiences of different countries and how their rural communities cope with the effects of climate change. The chapter also describes how rural communities adapt to climate change with limited resources they have. The study also touches on International Policy Responses and International Legal Frameworks on climate change.

The potential climate change adaptations in developing states are also discussed in this chapter. The main focus on Africa as a developing country is on the relationship that South Africa, as a main country according to this study has with other neighbouring countries is also discussed in this chapter. Some of the neighbouring countries share borders with the North West and Limpopo provinces.. It is assumed that some of the coping strategies and adaptation strategies from the neighbouring countries would assist South African communities in dealing with the effects of climate change.

Africa is predicted to be one of the vulnerable continents likely to suffer severe effects of climate change particularly Sub-Saharan Africa. With land area nearly 30 million square kilometres, majority of African communities depend on agriculture and natural resources for living. It has a wealth of natural resources unmatched by most parts of the world. Its wealth includes minerals, forests, wildlife, and rich biological diversity.

Even though Africa has so much wealth of natural resources, this wealth is unevenly distributed amongst its countries. For example, it has 20 of its tropical rain forests in the Democratic Republic of Congo, its major share of water is in few basins such as Zambezi, Nile, Niger, Congo, and Lake Victoria. This is not compatible with the fact that most African states are under water stress.

According to United Nation Development Programme (UNDP) (2010), more than 1200 million people do not have access to clean water and contaminated water has already caused more than 5 million deaths every year in Sub-Saharan Africa. Africa is characterised by (a) bad government structures, (b) poverty and less developed communities, (c) very low income per capita, (d) high rate of mortality and morbidity, (e) violent armed conflicts, (f) failed and fragile states, and (g) high levels of illiteracy (Moques et al. 2008).

According to Toulmin and Hug (2006), Africa's agriculture and natural resources provide livelihood for 70% to 80% of the population and account for 30% of GDP, and 40% of export revenue. This then

explains why the severity of floods and droughts in Africa is enough to wipe off the population depending on climate for livelihood.

Research has already predicted that climate is changing at an alarming rate. Although the changes in climate affect the human race worldwide, billions of people living in developing countries are said to be more vulnerable to the impact of climate change (Hope, 2009; IPCC, 2011). Their vulnerability is due to the fact that they do not have enough resources to adapt to the impacts of climate change. They are challenged socially, technologically and financially. This has great influence on why they struggle so much with sustainable development. The effects of climate change have already affected the agricultural production and have made food security very difficult to achieve (Mubaya et al. 2010).

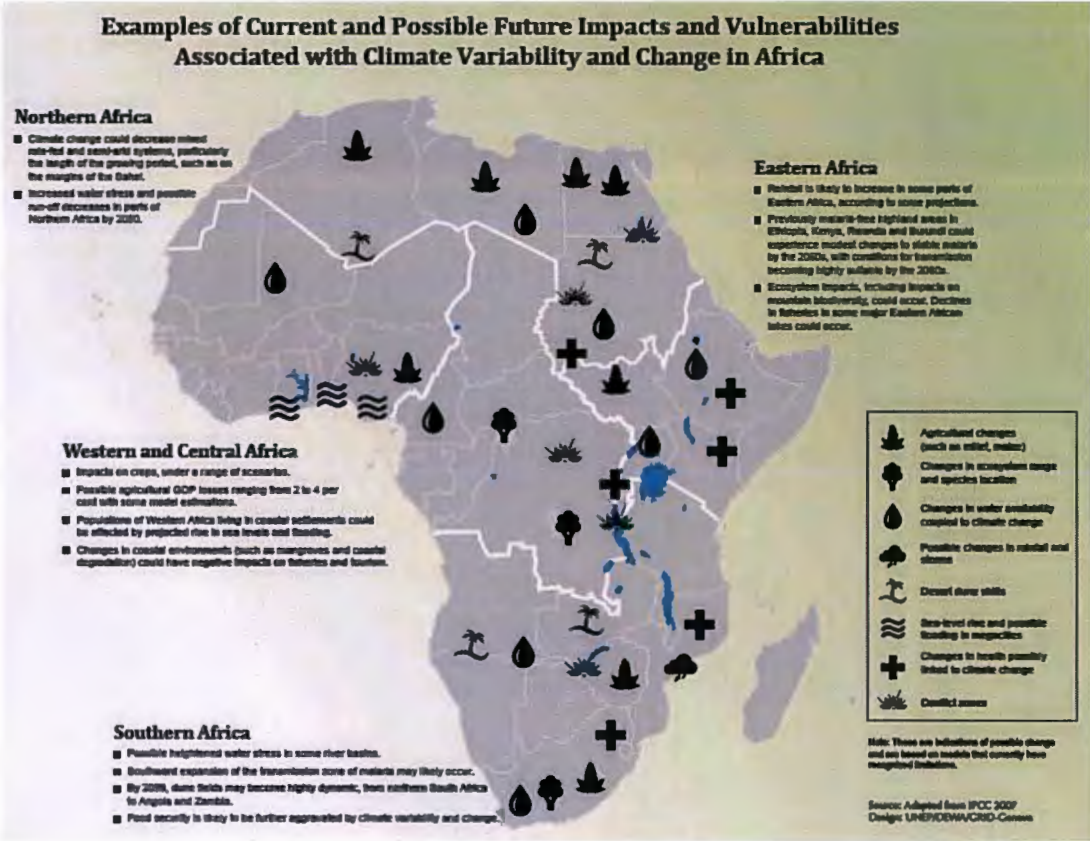
The unfavourable features of the African continent totally put all its inhabitants at risk to the effects of climate change. This vulnerability status results in worsening ecology, skewed distribution of resources, poverty and the spread of diseases such as HIV/AIDS and malaria. However, according to Lal et al. (2009), vulnerability can be reduced by adapting. Brown (2009) confirmed that many communities in Africa have adapted differently over the years depending on their locations.

For Instance, pastoralists in Kenya adopted a long time ago that whenever there was drought, they would move from one area to the one with better pastures, even if it means moving around over a year. In addition, rural Senegal and Burkina Faso farmers improved their adaptive capacity by pruning and fertilizing doubling methods of free densities in semi-arid areas. This has assisted them to reduce their desertification (Amusan, 2014).

More countries in Africa depend on rainfed agriculture and as a result, they are affected strongly by the effects of climate change. Even though most of them do not afford the technologies and modern equipment used by developed countries to adapt, their own affordable systems have carried them through. Some farmers in the Westen Sudan, the Bara area, introduced sheep when they realised that goats were dying and could not resist the severe droughts. Some South African farmers switched from livestock farming when they saw the reduction in their livestock production and their products and yet the feed was escalating. They switched from livestock to game farming (Turpie, 2010).

Due to the effects of climate change, most African states got their citizens migrating to other countries excercebating conflicts for food and resources. Farmers had to change their livelihood just to find jobs in other countries for survival. Although it has created tensions in some countries, it has benefited other countries in terms of skills tranfers.

Figure 4.1 Impact of climate change in Africa



Source: IPCC (2007)

4.2 EFFECTS OF CLIMATE CHANGE

Climate change is defined as a result of temperature variability due to emissions of greenhouse gases produced by human activities. According to Hope (2009:451), human activities such as ‘*burning of fossil fuels, industrial production, cutting down of rainforests change the atmosphere’s composition by increasing the amount of greenhouse gases, which, in turn, traps heat in the atmosphere and thereby facilitating climatic changes.*’ Hope, (2009). It is important to understand the impact of climate change in relation to the effects suffered when climate changes.

4.2.1 Changing weather patterns

Research has shown that climate change is characterized by changing weather patterns. It has been predicted that there will be unstable seasons in future (IPCC, 2008). For instance, Africa is mostly tropical with dry weather conditions, it is sub-humid and semi-humid.

According to Zhu (2010), Africa’s observations report that winter season lately is shortened by early spring and these changes make it evident that other ecological processes are gradually changing. The changing weather patterns make it difficult for people to plan for disasters. Farmers used to have their

planting seasons and the type of crops suitable for the particular season; lately, the seasons either delay or come earlier, and this disorganizes them and affects their crop production negatively.

4.2.2 Precipitation

When rain patterns change and do not come at a time they are expected, agriculture is affected. Although it is important for farmers to rely on weather forecast, it sometimes becomes difficult for some who do not have the advantage of switching to different crops. Whether it comes with storm or snow, the damage is done to the soil through soil erosion. Crops are also badly damaged and sometimes cultivation is made impossible by water logging of soils. When the quality of soil is damaged the yield of crops is compromised.

4.2.3 Extreme Weather Events

There is clear evidence of extreme events lately. The ever changing precipitation has led to very rainy low-pressures that often cause floods. According to Zoellick (2010), even though there is shortage of water, floods always bring misery to developing countries. It frustrates all intentions of rural development. Developing countries often use the budget allocated for development for disaster relief. For other commercial farmers, during floods, they take advantage and harvest more water because they have resources to do so. As for small-scale farmers, lack of resources and shortage of farming land are always at the top of their barriers to adapt list.

4.2.4 Droughts

Most of developing countries are negatively affected by severe droughts due to the fact that they rely on rain fed agriculture for food production. According to Mubaya et al. (2010), most sectors of the society rely on water for domestic and industrial purposes. Animals and plants are affected by shortage of water and loss of food during droughts. After severe droughts, land is left with poor quality soil and needs to be fertilized to produce better yields. However, Smith (2010) indicated that most farmers, after severe droughts, are often left with nothing and have to rely on relief funding or food aid. Shortage of water during droughts exacerbates water and food-borne diseases.

4.2.5 Heat Waves

It has been proven that heat waves can cause death. Recently, people died because of dehydration caused by heat wave across the world. According to Intergovernmental Panel on Climate Change (IPCC) (2007a), heat wave is projected to increase and impact negatively to the human race. It causes heat stress for plants and animals, as it also adds to the existing shortage of water. Veld and forest fires are known to be triggered by heat waves. In most areas, veld fires are regarded as natural disaster. It is not only costly to the environment but it is also a health hazard to both plants and animals. It is estimated that over 2.8

billion people globally stay in areas prone to different types of the physical manifestations of the changing climate including floods, storms, droughts and sea level rise (FAO, 2015).

The most vulnerable people live in the semi-arid dry land belt countries, Sub-Saharan Africa and most countries have different individual circumstances and specific impacts of climate change. This clearly shows that countries depend on the climate they experience influenced by their geographical, social, cultural, economic and political situations. Therefore it is evident that international assistance is needed to support adaptation for sustainable development, more capacity building and transfer of technology and funding to developing countries (IPCC, 2009).

4.3 IMPACT OF CLIMATE CHANGE ON AFRICA

At the United Nations Climate Change Conference (UNCCC) in Copenhagen, Denmark in 2009, a decision was taken to focus and prioritize the impacts of climate change on developing countries. This was because they had discovered that even though climate change is a global threat, developing countries are more at risk. They also found that it was difficult to adapt and cope with the negativities that emanate as a result of climatic conditions. Their lack of capacity to adapt and lack of existing structures that would enable them to adapt would somehow delay their intentions of reducing emission (Chinowsky, 2011).

Studies show that global temperature is likely to rise between 2 and 4 degrees Celsius in the next century (Mubaya et al. 2010; Hope, 2009; Smith, 2010). It is reported that the change is likely to be felt by changes in the hydrological cycle. Annual rainfall patterns and seasons will also change. The extreme events are also predicted to increase causing severe floods and droughts. This background then poses a question of whether developing states will survive this, hence the decision by UNCCC to prioritize developing states.

The implication for deciding against that would be to allow millions of people in developing states to be pushed into poverty and unsustainable development. This would turn economic growth in developing states to an uphill very difficult to climb, without adaptation and mitigation (Thornton et al. 2010). Climate change will make it difficult for developing countries to achieve their Millennium Development Goals (MDG); however, if developed states could reduce their emission, they would off-load developing states poverty load (Hope, 2009).

Factors such as poverty, illiteracy, lack of skills, weak institutions, limited infrastructure, lack of technology, low levels of education and health care alone exacerbate the situation. These factors then leave a situation where there is poor access to resources, low management capabilities, over exploitation of land resources and increase in population, which remains a threat (UNDP, 2006). The common impact of climate change is discussed below.

4.4 IMPACT OF CLIMATE CHANGE ON WATER IN AFRICA

In rural communities of Sub-Saharan Africa, millions of people suffer shortage of water which translates to lack of access to clean, safe water. Africa's large rivers such as the Nile, Niger, Congo, Zambezi, and Lake Victoria have always provided Africa with water for decades, but studies show that Africa is the world's driest continent. There is a debate that there is shortage of water in Africa, but those who dispute put forward the argument that the shortage of water is due to uneven distribution of water. People are more populated in areas with little water. Still others support the notion that there is poor management of existing water resources (Bourne, 2012).

A fact about water in Africa is that it is reported that more countries are already in water crisis. Nearly 51% of sub-Saharan African countries lack access to clean and safe water supply. More countries share rivers and lakes, and nations such as South Africa depend on water supplied by other countries such as Lesotho (Nyong and Kandil, 2009). Tanzania has three rivers that supply water; two of three have reduced flow because of reduced rainfall, which has had an impact on water, low agricultural production and increase in infections and disease, as well as decreased biodiversity (Mashingo, 2010).

According to Manase (2012), the effects of climate change on water resources in Africa are such that they come in the form of drought, change in rainfall patterns, floods, melting of glaciers and cyclones. Tanzania is fed by glaciers of Kilimanjaro; recently they have been melting affecting most agricultural production areas. Bangadi Basin in Tanzania is the source of drinking water, irrigation and hydropower production. It caters for more than 3.7 million people. With climate change impact on productivity, its sustainability is threatened.

4.4.1 Impact of rising temperatures and irregular rainfall patterns on Africa's water

Tanzania is ranked the 3rd country after Sudan and Ethiopia for owning large numbers of cattle (Mashingo, 2010). In 2009, there were 19.1 million cattle, 13.6 million, 3.6 million sheep, 1.6 million pigs, 56.0 million poultry recorded in Tanzania, and pastoralists are divided into three types, pure pastoralists, agro-pastoralists and intensive agro pastoralists.

Due to reduced rainfall and high temperatures, their livestock have been reduced. What is more interesting is that even wild life animals such as pigs, rats, kanga, buffalo and antelope have disappeared. This means that food production is reduced as well and food security is threatened. However, most pastoralists have adopted zero grazing instead of nomadic type of animal grazing, and they have changed to new breed of animals that are more resistant to diseases (Maclean, 2009).

It is important to mention that the study of the impact on water availability and use in Limpopo river basin by Zhu (2010), shows that Limpopo River Basin covers about 412 thousand km² and spreads over

four countries namely, Botswana, Mozambique, South Africa and Zimbabwe. About 45% of the basin is in South Africa, 19% is in Botswana, 21% in Mozambique and 15% in Zimbabwe. This river basin has also suffered shortage of water through high temperatures and lack of rainfall. The study finds out that the water availability in the basin is already stressed and if irrigation is said to be one of the best adaptation strategies for farmers in this country, water infrastructure and management interventions will improve the situation by 2050, if climate change continues in the same manner (Zhu, 2010).

It is of importance to this study to understand the depth of the impact of climate change on the availability of water in the region, especially when on record Africa has the longest river, Nile, whose catchment area is shared by 11 countries. About 200 million people live in this catchment area. Due to reduced rainfall, increased temperatures and more evaporation, the river Nile is at risk of shortage of water.

It is also confirmed by IPCC (2011), that because of climate change, the quality of stagnant water becomes easily contaminated due to high temperature. In both coastal areas and inland, climate change affects water quality. Heavy rainfall causes soil erosion, increased runoffs easily sweep away all chemicals and surface dirt into rivers and streams even the ground water systems eventually impair the quality of water. Again when water supply is decreased, contamination becomes more concentrated. As indicated rising water temperatures also affect the quality of water by increasing organic matter decomposition as nutrients in the lakes and rivers are not able to dissolve enough oxygen.

Rising sea level in coastal areas also reduces water quality and availability. Ground water quality is also affected by sea level rise through intrusion of saltwater, which has a potential to cause chaos in terms of fresh water supply. In most rivers and lakes in Africa, over recent decades, there have been changes in water nutrients content, Salinization of ground water concentration of pesticides and whole lot of other pollutants which have affected the quality of water.

Even though developing countries have their different individual circumstances and specific impact, there are sectors that cut across and are affected by shortage of water. Due to high temperatures and change in the rainfall patterns, West Africa levels of rivers have dropped and this threatens their economy (Mashingo, 2010). Mali is dependent on the Niger River for food, water and transport. Shortage of water in this river has caused crises and has affected most of other sectors like health, as people are forced to drink and use the polluted water because of low levels of water (Nyong and Kandil, 2009).

South Africa is also viewed as water stressed country with total groundwater use estimated at 15% over 65% of surface area. The reduced rainfall has impacted negatively on water availability and quality, in particular rural areas of South Africa. Rural farmers in the region use their own affordable tactics to sustain their food production even in the struggle with water. They have started to harvest water during the rainy season and keep it for the dry seasons (Deonaria, 2014; FAO, 2012; IPCC, 2011).

As the temperature continues to rise, and more droughts taking place more threats to the availability of water become realities. Although generally rainfalls are good and appreciated by humans, plants and animals, the heavy rainfalls also have their disadvantages. Heavy rainfall becomes a burden to poor communities where there are no proper water management systems. The purification plants are meant to assist people to get fresh water, but when heavy rainfall takes a longer period than expected, purifying plants are unable to meet the demands and leave the supply of purified water inadequate.

4.4.2 Impact of drought on Africa's water

According to Hope (2009), droughts result in water problems caused by either rain or snowfall, last for months or years; it is caused by extended period of below average precipitation. When there is drought crops and animals suffer more than humans, but both can also cause starvation if alternative for the supply is not available. Botswana is very tropical and dry. Erratic and unreliable rainfall has resulted in drought in most parts of the country. As a livestock rearing country Botswana has had to deal with severe droughts and increasing temperatures.

This condition affected most of the livestock and their feed and compelled farmers and government to develop adaptation strategies such as (a) farmers resorting to rearing more of the Jersey and Brown Swiss cattle, which are small framed, requires less feed and able to walk a long distance looking for food and water, (b) they resorted to producing their own fodder which was cheaper and more safe than having animals dying in the middle of a desert. Aganga et al. (2010), further stated it has been traditionally a practice that during such dry seasons and droughts, pregnant cattle were kept home under a white painted roof shelter in order to reduce solar radiation; and the animal was continuously showered with cold water with springlers to cool off the cow.

According to Atouga (2013), in most parts of Southern Africa, many countries were expecting Elnino through their weather forecast and they underestimated its intensity. It came as a surprise to many that it came with such severe droughts. This has caused nearly 16 million people to go hungry due to Elnino related drought and erratic rainfall.

Zimbabwe was once the bread basket in the Southern African region, it has turned into the worst hit country, where on several occasions it declared a state of disaster due to drought. Its economic state could not assist the agricultural sector even though it was the main economic sector due to shortage of water. The irrigation systems that used to effectively boost food production collapsed due to lack of financial and technological maintenance which eventually created massive shortage of food. There used to be one big drought every ten years and this gradually increased to one drought every five years, the pattern is now different, there is drought every three years and this seems to be a new norm that signals a crisis in water availability.

4.4.3 Impact of Floods on Africa's water

Half of Nigeria's population also struggles with access to clean water, due to the fading supply of quality water. Mount Kilimanjaro's glacier has disappeared due to climate change and that is bad for the supply of water. Frequent floods have also destroyed livelihoods in most parts of Africa. Africa faces increasing water scarcity, which makes agricultural production very difficult as it relies on rainfall for irrigation (Schulze and Horan, 2010).

In the beginning, people selected suitable areas where they could settle and enjoy the fertile land with easy access to water, and they used to enjoy the floods as they came with their own benefits. For instance, those who settled in ancient Egypt benefited from the flooding of the river Nile as they brought with them needed nutrients to their irrigated soils. Lately, floods are seen as extreme natural disasters that bring risks to all living beings (Deonaria, 2014).

The bigger part of Africa is threatened by floods, and most prone areas are in North Africa, where they normally cause disasters. Africa's floods occur in both arid areas and humid areas. The worst countries prone to floods are Burkina Faso, Chad, Ethiopia, Ghana, Kenya, Liberia, Mali, Niger, Nigeria, Senegal, Sudan, Togo, Uganda and Rwanda. Millions of people died and many others were left displaced, where there have been more conflicts due to lack of food, shelter and health care.

Research has proven that floods are natural disasters that cause death, displacement, injuries, contamination of drinking water, and destruction of infrastructure (roads and buildings and electrical services). Most parts of the world have been affected negatively and positively by floods. It has taken different forms in different areas. In some areas it happened over a period of weeks and others months. Due to climate change, it has been highlighted that the scale and frequency of floods have increased lately (Sterman, 2009).

According to Mamase (2009), seasonal floods or river floods are those that are caused by seasonal precipitation and melting of snow. The flash floods or tropical floods on the other hand are those that are often accompanied by heavy rainfall which fills up streams and rivers to a point where they cannot handle, and lastly, the coastal floods caused by over flow of oceans due to storms, strong winds and other weather events.

According to Mubaya et al (2010), floods have impacted on developing and developed countries and the damage cost has always been difficult for developing countries to recover. Floods have affected individuals and states alike. They have been threats to peace in most regions and they caused economic losses, however people have always come up with strategies to deal with floods. Some build dams to divert and regulate the flow of water and some harvest water into tanks to reduce overflow. Unfortunately, for some people, due to their geographical location, they are always left with one option of

leaving their residential area to squat in higher ground to await the floods to subside. However, in urban and developed areas, people rely on early warning systems and have enough time to plan and prepare for the floods (African Ministerial Conference on the Environment (AMCEN), (2011).

According to Water and Energy Commission Secretariat (WECS) (2011), climatologically, flood is caused by prolonged rainfall and ice melting. Some floods are caused by excessive storms and high speed winds, and earthquakes or excessive overflow of water to dams. In any other form, floods threaten the people in different ways. The physical impact is that floods are felt through loss of infrastructure, house, schools, clinics, power supply, water supply, transport and communication services. Economically, people are affected when they lose their businesses, markets and trade activities, their access to jobs and losses of their income. The environmental effects of floods are also highlighted in terms of the damage to the landscape, biodiversity, damage to arable land, and loss of chemicals in the soil.

In most vulnerable communities, people have learnt to live with floods and have their way of coping. Some use flood or disaster insurances to cover their properties and businesses. Many others use the terracing of land and soil conservation measures as best alternatives. In Nepal, more people save food and valuables for the flood seasons. They also save animals and their feed and when there are severe floods they release the animals and then migrate to safer areas (Manyumba, 2012).

According to the reports of World Health Organisation (WHO) (2013), in Southern Africa countries such as Zambia, Zimbabwe and Mozambique, heavy floods cause disasters to health systems, the increases in diseases such as Malaria, Diarrhoea and Skin diseases due to lack of clean water and sanitation, stagnant water was once a regional crisis. People could not access medical health services due to destroyed infrastructure such as roads, clinics and neighbouring countries such as South Africa have to assist.

4.5. IMPACT OF CLIMATE CHANGE ON AGRICULTURE IN AFRICA

Africa regards agriculture as one pillar of economy that provides both food and employment to urban and rural communities. However globally, the changing climate has affected agriculture through its increase in temperature, shortage of water due to floods and droughts, frequent heat waves and veld fired, and periods of heavy precipitation. The African continent has always been warmer than other continents however, with rapid climate warming globally the changing climate continuously causes rising temperatures and more unreliable precipitation. The changing climate has the potential to expose all people living in Africa and elsewhere in the world to hunger and starvation due to agricultural failures caused by climate change.

Droughts, heat stress and flooding have led to the decrease in production of crops and livestock. According to IPPC (2014), East Africa is facing the worst food crisis, about 12 million people in Ethiopia, Kenya and Somalia are in dire need of food. Rainfall has dropped. The year 2010/2011 was the

driest of the years. Most African countries depend on agriculture for livelihood. Through climate change the production of rain-fed crops has become more difficult.

Even though Africa is regarded as the poorest continent with lack of resources, African farmers have always coped with the effects of climate change. According to research done by Bryant (2009), Gbetibouo, (2009), Maponya, (2012), and Mallikarjuna (2013), farmers in Africa have long known that they are vulnerable to climate change and have devised their own coping strategies. Their strategies may not be the best in as far as they are compared with the modernised ones, but they have always worked for them.

The Impact of climate change on agriculture in Africa has not only been bad on the economy of many countries, but has negatively affected the livelihood of people living in Africa, due to their dependence on natural resources and agriculture which are highly dependent on climatic conditions. This renders the continent incapable of feeding its own people to a point where most of the countries in Africa find themselves dependent on foreign assistance to sustain food security (Amusan, 2014).

Kenya has been affected by in the 1990s and the El Niño rains that caused floods and in 2010. These climatic changes directly affected agriculture through reduced crop production and livestock shortage. Most people in Kenya stay in rural areas, as a result they rely on rain fed agriculture and other natural resources for livelihood (Nhemachema, 2010)

Generally, many countries in Africa rely on rain fed agriculture and are more vulnerable but of importance is how their rural small scale farmers are affected. This makes them vulnerable to the rising temperatures and lack of rainfall that reduces their yields. Rural communities have very limited choice in diversifying their crop production and enhanced income sources. Vulnerability of most people living in Africa in relation to climate change and its extreme weather events is the fact that they live in poverty where there are low levels of education, lack of access to technology and information and high levels of corrupt and unstable government institutions.

Food security for subsistence farming is highly compromised under climate change due to agricultural land that is lost. There are shorter growing seasons and lower yields because of the changing climate. Severe impact on agriculture has increased poverty in small-scale farmers due to low production of food. Poor communities are forced to rely on high priced food (Neves and Du Toit, 2013). Droughts, floods, and high temperatures have made it difficult for agriculture due to the changes in sowing seasonal dates because of later or earlier start of the wet seasons.

In the major African countries, Agriculture is the major pillar of the economy and this becomes a challenge to the continent when it starts to perform poorly due to the changing climate. Even though Agriculture has been the principal driver of the economy in most African countries for decades, some

countries have started to look for other sectors that can sustain the economy due to the declining agricultural economy. For instance, countries such as Mauritius and South Africa have become less dependent on agriculture and have grown other sectors to enable them to sustain their growing populations.

As much as agriculture is crucial for most African countries, water is also important to see agricultural activities through and successful. A decrease in rainfall and increase in precipitation irregularities negatively affects agricultural production. In some countries where there are resources to adapt to the impact of climate change, the sector still copes with the effects of the changing climate.

In South Africa, for instance, commercial farmers have resorted to irrigation systems to sustain their agricultural activities, and hence still remains one of the maize producers in the region, followed by Tanzania. While some African countries cannot produce their own maize and sorghum to the satisfaction of the demand for the crops, they import additional food from South Africa (Ayinde, 2011).

In the midst of the changing climate, it has been proven that the major influence of climate change to agriculture is the availability and management of land, its fertile soil and water. These are negatively affected by frequent extreme weather events caused by the changing climate. Due to the sensitivity of crops that depend on weather, other crops such as wheat will be affected by the opposing effects of temperature, precipitation that may hinder the growth and development of wheat. However, in other parts of the world like China, the increased temperatures due to the changing climate bring high yields of wheat (Zhang and Huang, 2012.)

Maize is one crop used as staple food for most countries in Africa, however, it grows under different conditions in different countries. Since different areas are affected differently by climate change, effects of the changing climate such as heat stress and droughts are more severe to maize as they decrease maize grain yield and the quality of starch granule and the size. The resilience of maize crops to different climate change is related to pests and diseases under changing climates. Any change in the normal seasonal or environmental condition like rainfall patterns, and temperature has the ability to change growth and development of the maize (FAO, 2012).

As the demand grows for organic crops and fruits all over the world, for some fruits the changing climate threatens their existence in certain areas. In some areas where the fruits are supposed to be thriving because of available carbon dioxide, the unavailability of enough water frustrates the growth and development of nutrients in the fruits. Fruits in different areas are vulnerable to the increasing risks of frost, hail storms, water shortage, diseases and pests related to heat and high temperature (Bruan and Markus, 2012).

Africa gets its fisheries in most of its lakes, rivers and oceans, which provide food for people in most African countries. Fishery provides work for many people in Africa and at the same time provides healthy food. The demand for fish has grown over the years, with more people giving appreciation to the health aspects of white meat. However, fishery is one sensitive industry to climate. The warming of the temperate ocean can destroy the entire fish if it keeps on changing unfavourably. On the other hand, the way the fish population responds to the changing climate will differ between climate variables and species (Milner et al. 2009). Heavy floods introduce diseases or predators to the fish harming industry.

According to Madzwamusi (2012), through negative impact on agriculture, climate change worsens the food chain which threatens availability of food. This does not only affect the food production but also the livelihood of people in Africa is affected by the downfall of the agricultural sector. Most farmers, fishers, pastoralists, and forest dependent people make a living out of this sector and their accessing of food and income depends on it.

As much as climate is an integral part of livestock production, climate change can impact negatively on the quality and quantity of livestock produced (Gbetibouo, 2009; Ringer, 2009). Different animals respond differently to climate change and they give a different response in different areas. This was substantiated by Wermuelen et al. (2012), citing that when temperature is lower or is higher than their production scale, quality is compromised.

Hamilton (2012) supported the argument by explaining that excessive heat impacts on reproduction, milk production, and growth of animals. Heat stress is one factor that limits effective production of quality animal protein. Besides, heavy rain and floods increase the chances of insects that cause diseases in animals. Climate change influences the outbreak of animal diseases through its extreme weather.

According to Notenbaert (2010), changing climate through its floods, droughts, heat waves and desertification, introduces manifestation of insects and fast spreading diseases such as malaria, Leishmaniasis, Loiasis and Filariasis. Animals are very sensitive to temperature variations and failure of animal production has a potential to cause a great economic loss.

Bourne (2012) indicates that warming and changes in rainfall trigger changes in temperature and the distribution of diseases such as anthrax, septicaemia and black leg disease. Warm temperature also spreads bacteria and parasites. It has also been found that changing climate influences the spread of ticks and mosquitoes that transmit diseases (Sumil et al., 2010; Gregory et al., 2009; Nelson et al., 2010).

The effects of climate change on livestock in Africa alters their productivity and indirectly affects livestock through reduced fodder intake, altered immune system, shortage of water, proliferation of insects and bacteria that cause diseases. Consequently since Africa depends on animals for food, climate change brings a serious threat to food availability and sustainability in Africa.

Reports (IPPC, 2010; FAO, 2012) indicate that more than 65 per cent of people in Africa depend on rain fed agriculture which means that during floods and droughts, their income and properties are lost due to low income and production. One of the farmer's coping strategies is to use intercropping and crop diversification. They have their indigenous livestock such as Nguni breed, which are drought resistant in South Africa. In other parts of Southern Africa such as Sudan, farmers introduced sheep in place of goats for climate change resistance (Bourne, 2012; Castello et al., 2009).

4.6. IMPACT OF CLIMATE CHANGE ON HEALTH IN AFRICA

Climate change has affected people living in Africa directly and indirectly through its impact on human health (Mandleni, (2011)). It has been found to be directly affecting human health through deaths and injuries that take place during climate related extreme weather events (Gregory et al., 2009). With rising temperatures and the heat waves people die and still others suffer due to thermal stress. The unreliable precipitation often comes with different ailments that affect the health of people living in Africa.

According to Deressa (2012), more deaths are caused by vector-borne diseases such as Malaria and dengue fever. These diseases are caused by the spread of mosquito bites and other insects. Muhenga (2011) supported that about 2.7 million people died in African countries due to Malaria. This has been prevalent in the eastern, central and Southern Africa. Ghana and Kenya have been reported to be the highest infected in the region, due to their location. However, it has also been reported that malaria has spread to other areas such as the highlands of Ethiopia, Rwanda and Burundi (Azongo et al., 2012).

It has its annual outbreaks related to increased rainfalls in tropical dry regions and increase of temperature in cool areas. Most poor people living in Africa are vulnerable to Neglected Tropical Diseases (NTDs). These are disabling conditions that affect most people World Health Organisation (WHO), (2015). It has also been reported that more than 350 million suffer diarrhoeal diseases, caused by droplets or saliva, but spread like veld fire. This is responsible for the mortality of the vulnerable groups in Africa. Diarrhoea is water-borne and with the rising temperatures and unavailability of water in most parts of the continent diarrhoea becomes prevalent (Smith et al. 2014).

According to Lloyd (2011), more challenges in health in African countries are created by the changing climate through the contamination of air, water and open sewerages. If African countries were not so poor and could manage their health facilities very well, these pandemics would not be as severe as they are. The physical infrastructure and medical resources need to be improved to address the challenge of health in Africa.

The effects of climate change on agriculture and food availability have a direct effect on the health of people living in Sub-Saharan Africa (Fintel, 2013). When majority of the population is undernourished due to shortage of food, there is a high risk of diseases that will come out. High levels of poverty and

unemployment put African societies in high risks of climatic diseases and people migrate from one place to the other carrying with them diseases and spread them in areas where such diseases were not present (Smith et al. 2014).

Many migrants settle in areas where there is risk in hygiene and sanitation. They settle where there are no ablution facilities. It is either in the steep and stable hillsides of flood plains or lowly, where it is difficult to bring proper services. Due to lack of proper services and water infrastructure, people tend to use and drink contaminated water (Douglas et al. 2008).

It is also highlighted by Amusan (2014), that migration due to climate change fuels more of the conflict that takes place in the continent. Due to the shortage of resources and population growth in every country, it is believed that when people migrate to a new place they bring with them diseases. Even those who never migrated believe that those who left brought with their diseases, in particular diseases such as HIV/AIDS.

When people are displaced due to extreme weather, most of them struggle to put their lives together again, some suffer stress and depression. For some, it goes to the point of mental disorder. Severe floods have caused famine and malnutrition in most developing African countries. This has caused the spread of diseases through migration, conflicts, shortage of water and food insecurity. Malnutrition has caused so many deaths in Africa in particular on the vulnerable groups such as women, children and the elderly. FAO (2014), estimates that over 1.7 million people die of malnutrition in Africa. Most countries in Africa are very food insecure due to the effects of changing climate.

4.7 INTERNATIONAL LEGAL FRAMEWORK

According to studies on climate change conducted by Hope (2009); WECS (2011), IPCC (2007), and Sithole (2009) globally, Climate change has become a threat to living beings, and it results in the need for international intervention. History shows that a group of scientists from all over the world conducted studies to determine the extent of its impacts in order to come up with strategies to deal with it. Their recommendations led to several countries coming together in 1988, to discuss the impacts of climate change.

That meeting resulted in the formation of International Panel on Climate Change (IPCC), which was followed by the establishment of United Nations Framework Convention on Climate Change (UNFCCC) in 1992. Under this convention, countries gather and share information on greenhouse gas emission, national policies and best practices. Strategies and funding of support to developing countries is also discussed (Madzwamuse, 2010).

According to Sithole (2009), the Kyoto Protocol binds developed countries to reduce Green House Gas (GHG) by 5.2% between 2008 and 2012. Parties are expected to cooperate at regional and international level to promote the success of the Protocol. Globally, many debates have taken place in the form of Congress of Parties (COP), where parties meet to agree on specific policy framework to guide responses to climate change. Madzwamuse (2010) expresses that since climate change is a global problem, it requires engagement of stakeholders at National and Local levels.

The second commitment began in January 2013 and is set to end in 2020. The 2015 Convention meeting in Paris in December 2015, got parties to agree on the need to accelerate actions and investments needed for a sustainable low carbon future. Countries also agreed to strengthen their ability to deal with the impact of climate change (UNFCCC, 2015).

Globally, countries are expected to adapt to climate change. In terms of adaptation, Article 4.8 and 4.9 of the UNFCCC, and Article 3.14 of Kyoto Protocol, parties are required to take measures to reduce the effects of climate change on developing countries (UNFCCC, 2015). According to Baer et al (2008) both Articles state clearly that measures to combat climate change should not limit the ability to develop and give attention to the needs of the poorest and vulnerable sectors of their society.

South Africa, like all other developing countries, had expectations from the last Congress of Parties (COP) 21 in Paris. According to Department of Environmental Affairs (DEA) (2015), South Africa expressed its wish for a cooperative implementation of the global responsibility for adaptation by all parties, and urged developed countries to heed the call to provide climate finance that will enable developing countries to enhance their actions towards achieving the objectives of the Convention.

South Africa also joined Africa's call for developed countries to establish international capacity building mechanism and be supported through financial and technology mechanisms to achieve their adaptation and mitigation objectives. Madzwamuse (2010) emphasizes the dire need to have policy responses to ensure efficient adaptation.

4.8 INTERNATIONAL POLICY RESPONSES

There is a growing consensus that climate change needs international collective action. Policy responses have been done through international negotiations and so far slowly implemented. The principal focus is on reducing carbon dioxide emission, which perpetuates climate change. It is therefore important to have all institutions and bodies that are directly affected by the impact of climate change such as the UNFCC, Food and Agricultural Organization (FAO), World Bank and the World Health Organization (WHO), to work together and assist developing countries with whatever resources needed for them to respond effectively to the effects of climate change (Mubaya et al., 2010).

According to Madzwamuse (2010), climate change is a threat that has taken the world by storm. Collectively or individually, countries have to make means to respond in a form of legislation, policy or framework but an action needs to be taken urgently. However, since the changing climate cannot be considered a responsibility of one country or region, it requires a global solution.

Cassie (2014) substantiated that United Nations and other international organisations took it upon themselves to ensure that an action is taken to adapt to climate change and to start mitigating it. This initiative has turned into an endless effort by all member states who believed in the work given to the Intergovernmental Panel on Climate Change Convention, responding to the changing climate. Many meetings and conferences are taking place to ensure commitment and participation by most of the countries.

According to UNFCCC (2016), since the last Conference of Parties (COP) 21, that was held in Paris in December 2016, the Convention has made a remarkable progress in getting more countries to commit on emission of global greenhouse gases. The aim of the conference was to do the following; Firstly to strengthen the global response to the threats of climate change by holding the increase in global temperatures below 2°C above pre-industrial levels and pursue limiting temperature increase to 1.5°C above pre-industrial levels.

Secondly, to put more effort on increasing the ability of developing countries to adapt to the impact of climate change and find appropriate climate resilience and low greenhouse gas emissions implemented in a way that would not negatively affect food security. Lastly, is the provision of finance to deserving countries through appropriate systems towards low greenhouse gas emission and climate-resilience. World Bank (2016), confirms this was considered the world's most comprehensive climate agreement.

It is reported by IPCC (2016), that about 194 UNFCCC members have signed the agreement, and 133 ratified the treaty. This commitment of ratification by so many countries qualified the agreement to be put into effect in November 2016. This, in simple terms, means that the agreement will now start to operate as "Paris Climate Agreement International Law." This has been a milestone on all the efforts of countries (IPCC, 2016).

4.8.1 United Nation Framework Convention on Climate Change (UNFCCC)

In an effort to address the issues of climate change decades ago, when most countries joined the international treaty, UNFCCC was born in 1992. Its role is to support all institutions dealing with climate change process, to identify its impact and come up with global responses to climate challenge. Kyoto Protocol on 1997, legally bound countries to emission targets by 2012. Despite these efforts, some countries, including big emitters, remained outside the agreement. Parties continue to negotiate with

states and institutions to commit to assist with adaptation initiatives. In 2013 other targets were set which will end in 2030.

Table 4.1 Brief Summary of International Climate Change Policy Responses

YEAR	International Negotiations Towards a Climate Change Agreement
2015	Intensive negotiations took place on the Durban Platform for Enhanced Action (ADP) throughout 2012 – 2015 and culminated in the adoption of the Paris Agreement by the COP on the 12 th December 2015.
2014	COP20 in Lima, parties adopted the “Lima call for Action” which elaborated key elements of the agreement in Paris
2013	Key decisions adopted at COP19. Decisions on advancing Durban Platform, Green Climate Fund and Long-term Finance, the Warsaw Framework for REDD Plus and the Warsaw International Mechanism for loss and damage.
2012	Doha Amendment to Kyoto Protocol pertaining to the first commitment period.
2011	Durban Platform at COP17, governments recognized a need to have a written legal agreement to deal with climate change beyond 2020.
2010	Cancun Agreements accepted at CO16. Countries made their emission reduction official.
2009	Copenhagen Accord drafted at COP15 in Copenhagen, countries submitted emission reductions pledges.
2007	IPCC’s Fourth Assessment Report is released at COP13.
2005	First meeting of Kyoto Protocol in Montreal. Parties launched negotiations on the next phase of Kyoto Protocol.
2001	Marrakesh Accords are adopted at COP7 detailing rules for implementation of Kyoto Protocol and setting up funding instruments for adaption.
1997	Kyoto Protocol is formally adopted in Kyoto at COP3
1996	UNFCCC Secretariat is set up to support action under the Convention
1994	UNFCCC enters into force
1992	At the Earth Summit in Rio, United Nations Framework Convention on Climate Change (UNFCCC) opened for signatures along with its sister Rio Conventions
1991	First meeting of Intergovernmental Negotiating Committee (INC)
1990	IPCC and second World Climate Conference call for a global treaty on climate change
1988	Intergovernmental Panel on Climate Change (IPCC) is set up
1979	The first World Climate Conference (WCC)

Source: (UNFCCC, 2015)

According to UNFCCC (2015), the 2015 Paris Agreement seeks to strengthen the global response to the threat of climate change by keeping global temperature rise below 2 degrees Celsius above pre-industrial levels, and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius. This report emphasizes the need for financial commitment to developing countries in order to enhance their capacity building.

IPCC (2016) reported that for the first time the Paris Agreement brings together all nations into a common goal to make concerted effort to combat climate change and adapt to its effects. It is an applaudable act of some of the developed countries to assist developing countries financially as a wayforward. The guidelines for all parties to follow a programme in order to ensure that the Paris Agreement is effectively and fully operational, was launched and embraced by all parties. The programme is expected to be completed by 2018 (UNFCCC, 2016). The Paris Agreement outlines crucial elements that need to be followed and they include;

- a) Long-term temperature goals (Art, 2) – the agreement reaffirms to combat global temperature increase.
- b) Global peaking (Art, 4) – in order to achieve the temperature increase to below 2⁰C, all parties should aim to reach global peaking of greenhouse gas emission immediately.
- c) Mitigation (Art, 4) – all parties are expected to prepare, communicate and maintain a Nationally Determined Contribution (NDC) and establish domestic measures to achieve them.
- d) Sinks and reservoirs (Art, 5) – parties are encouraged to conserve and enhance sinks and reservoirs of greenhouse gases.
- e) Voluntary cooperation/Market and non-market-based approaches (art, 6) – the agreement sets out principles for the possible voluntary cooperation among parties to allow for higher ambition.
- f) Adaptation (Art, 7) – the agreement enhances the adaptive capacity by increasing resilience with the aim of reducing vulnerability to climate change.
- g) Loss and damage (Art, 8), the agreement enhances the Warsaw International Mechanism on loss and damage to help vulnerable parties to cope with climate change.
- h) Finance, technology and capacity building support (Art, 9, 10, 11) – this reaffirms the commitment of some developing countries to support developing countries to deal with climate change impacts.
- i) Climate change education, training, public awareness, public participation, and public access to information (Art, 12).
- j) Global stock-take (Art, 14) – global stock-take should happen in 2023 and every five years thereafter.
- k) Decision 1/21 also elaborate on the set of measures to enhance action prior 2020, that strengthen the examination process, provision of urgent finance, technology and measures for high-level engagements.

4.8.2 AFRICA’S RESPONSES TO CLIMATE CHANGE

It has been proven that Africa is vulnerable to climate impact with less capacity to adapt; therefore it is important that they adopt mainstream climate change resilience into their national development plans. In

order for this to be achieved, African Adaptation Programme (AAP) was launched by UNDP in 2008, in support of long-term efforts of countries to build capacity in order to deal with climate change stresses. The programme started in 2008 and ended in 2012. Twenty countries participated in the programme from across the continent. South Africa was not a beneficiary in the programme. Many countries benefited from the AAP as they participated in programmes such as planning, leadership, institutional capacity building, climate resilient policies, innovative finance and knowledge generation and sharing. It was reported a success by the UNDP. (UNDP, 2013).

From Africa's perspective, regional organizations such as New Partnership for Africa's Development (NEPAD) joined in to support global attempts to address issues of climate change. With the support of the German government, NEPAD established a Fund intended to support African Union (AU) member states and Regional Economic Countries (RECs) and other institutions that meet the funding criterion. The Fund is meant to assist the adaptation of agriculture, biodiversity and development in member states. It is again an opportunity to support National Adaptation Plans (NAPs) and the mainstreaming of climate change into National Agricultural Investment Plans (NAIPs).

Since most African states are vulnerable and lack capacity, the Fund covers activities such as training and capacity building in smart agriculture and biodiversity conservation adaptations. Awareness education and training for government decision makers, private and public institutions are also covered by this Fund. The intension is to support even the already proven measures and instruments used at regional and national level, so that the region can share good lessons learned (NEPAD, 2014)

To enforce its commitment on climate change, AU got into partnership with German Federal Ministry for Economic Cooperation and Development to improve livelihood in Africa. Comprehensive African Agriculture Development Programme (CAADP) was then established by AU, as a framework for agricultural development across Africa. It helps member states to identify and implement agricultural adaptations to enable them to meet climate change challenges, by designing effective agricultural policies, and strategies including investment programmes. Poor rural communities are the main focus as the programme runs from 2012 until 2017 (AMCEN, 2011).

For the Southern Africa Development Community (SADC), the priority is reducing the impact of climate change on development, to adapt and cope. SADC has also signed on to UNFCCC and Kyoto Protocol. Its efforts in enforcing the agreements are seen in the development of policies and strategies to address issues of climate change. SADC Treaty seeks to assist states achieve development and economic growth, alleviate poverty and enhance the quality of life using available resources and protecting the environment.

In addition, a regional Indicative Strategic Development Plan (RISDP), was drawn to ensure coordinated regional position in the negotiations and implementation of MEAs agreements. During its summits,

SADC emphasizes the need for urgent attention to address climate change adaptations, hence its active participation in international climate change negotiations in UNFCCC and Kyoto Protocol and Regional African Groups level (Lesolle, 2012).

Economic Community of West African States (ECOWAS), also established a Strategic Program to Reduce Vulnerability and Adaptation to Climate Change. Most vulnerable sectors within ECOWAS are the coastal areas and fishery activities, agriculture, forestry, water and energy resources, human health and tourism. These are sectors that are holding the economies of states in West Africa.

The region cannot afford to have groups such as small scale and livestock farmers, coastal zone residents, poor and marginal groups destroyed by effects of climate change. ECOWAS Climate Change Adaptation Strategy seeks to strengthen the scientific and technical capacity for adaptations. It also assists member states to integrate aspects of climate change into development policies, programmes and projects at Sub-regional and national levels (Atouga, 2013).

4.9 CLIMATE CHANGE ADAPTATIONS IN AFRICA

It has been evident that Africa is more vulnerable to the impact of changing climate because the continent is affected in different ways. Although many African countries share similar difficulties in as far as adapting and coping, one common factor amongst them is that they lack enough human and financial resources to effectively adapt to the changing climate. Many of them are undeveloped and poverty reigns, so the physical impact of climate change has negative implications on their economies, leading them to poverty, hunger and food insecurity (UNFCCC, 2010)

Research has shown that most of them rely on agriculture for survival (Mabuya et al. 2010; IPCC, 2012; Mc Naught et al., 2014; and Smith, 2010). Due to the changing climate, many are experiencing extreme weather events such as heat waves, floods, droughts and abnormally high temperatures. The future projection also shows the possibility of warmer and drier temperatures, which will cause severe shortage of water, soil infertility and soil quality loss (Christensen, 2007; Madzwamusi, 2010; UNFCCC, 2010).

After proclaiming that climate change was moving in a faster speed than expected, the IPCC decided that all societies needed to know more about climate change in order to enable them to address it effectively. Above all, societies need to understand that climate change can be managed if well adapted to or mitigated. There is enough evidence to prove that climate change has its biological and geographical changes and because of that there have been changes in seasonal patterns and retreat of mountain glaciers as well as decline in animal and crop production (Boko et al., 2009).

According to Maddison (2007), most Africa countries are dependent on agriculture as their pillar of economy. People generate their livelihood and wealth around the climatic patterns and this allows them

an opportunity to develop their own coping strategies. For instance, in the rural areas of Tanzania, as a way of coping with the effects of climate change, pastoralists always move from one place to another searching for suitable pastures for their livestock.

Mashingo, (2010) and Amusan (2014) agree that even though pastoralists found a proper coping mechanism, in some countries such as Nigeria, Niger, Sudan, Ethiopia etc, this migration has fuelled conflicts due to shortage of natural resources such as water and grazing land, in some areas, the conflict often erupts between pastoralists and farmers for natural resources. However, when well managed, the strategy works and produces better livestock production results.

In most African countries, irrigation is used as an adaptation strategy and it works well. However, for small scale farmers in most countries, the system comes out very expensive for them to afford. As a result their crops die when there is drought. For example, Zimbabwe used to use irrigation system for most of its agricultural production, but since the economic situation of the country deteriorated, most farmers lost their production even in the presence of irrigation system because they were becoming very expensive to maintain in the absence of the high demand of crops and markets (Ngigi, 2009).

According to Chambwera (2010), in order for societies to be able to effectively adapt, they need to have access to adequate resource that will enable them to cope with the impact in their own areas. As suggested by Sen (1987), individuals and groups within society need to have entitlements that can be used as their resources in order to be able to cope with the changing climate. Farmers in Lesotho diversify their farming as their coping strategy to deal with the effects of climate change. For instance, they engage in both crop farming and livestock farming. When the production of crops has reduced, they sell their livestock to increase their income, for nutritional purposes and to provide safety nets (Maponya, 2012).

Most of Africa's vulnerable communities are affected by moving from one place to another, either due to civil wars, hunger, conflicts, natural disasters or climate change. Most are negatively affected by extreme weather events that leave them homeless. For instance, in countries such as Lesotho, some people settle in rural areas at coastal areas, hill slope and build their houses on flood plains. When the disasters come they are the first to be hit severely by these events. Therefore, the first form of adaptation for this people would be, to be relocated to suitable areas and avoid settling in high risk areas. The implication of this is that their already struggling governments should prioritize them in making sure that they are less likely to be affected by extreme events (Nyong, 2007; Lobell, 2008)

The areas of corruption and maladministration cannot be ruled out in the inability of African countries to cope with climate change. The inadequacy of institutions of power and lack of political will in most developing states are responsible for underdevelopment in most developing states, as a result when

adaptation processes needs to take place the people who decide would rather not prioritize it if it does not give them personal enrichment (International Fund for Agricultural Development (IFAD), (2010).

For example, in Nigeria, the government has prioritised petroleum resources more than agricultural development even when agriculture is predominantly in the hands of majority of small scale farmers (Zoellick, 2009; Amusan, 2014; Odjugo, 2010). The Nigerian government then should invest on its farmers on the knowledge about climate change so that they are more equipped in coping with climate change. The Extension services should be strengthened as a way of improving agriculture in order to protect and sustain food production.

According to Orindi (2009), this does not leave South Africa and Zimbabwe behind as the rural communities share the same sentiments. For instance, in a state where there are minerals that could be well managed by the state to ensure that their profits benefit the nation, priority would rather not be to involve affected communities but rather to develop policies that ensure the outsourcing of the mining project, so that those who are in positions of power can end up owning all the mining projects and their profits (IPCC, 2014; Mertz, 2009).

In this way, it has been evident in most Africa countries that conflicts are mostly created by uneven and skewed distribution of resources, which eventually divides the nations into poor and filthy wealthy people existing in as one nation. So the role of collective action in planning and identifying suitable adaptation strategies is still crucial to ensure that effective adaptations are adopted by African states (Chambwera, 2010).

To strengthen this notion, Amusan, (2014) cited the conflict caused by natural resources by members of the Lake Chad Basin Committee. Their conflicts which erupts more often because of the water resources and grazing area around Lake Chad, keeps shrinking due to the effects of climate change. Member states such as Libya, Algeria, Nigeria, Sudan and Chad have devised a strategy to negotiate commitment from these countries to allow Nigeria to lead the programmes on the efforts to strengthen their relationship on the transboundary nature of various rivers that supply water to Lake Chad. As an adaptation strategy these countries have agreed on capacity building that would assist them to share water equitable and peacefully through irrigation, fishery and animal husbandry. This is an attempt to encourage food production and bring political socialization (Amusan, 2014; Madu et al. 2010).

Because adaptation is not a costless exercise, it is important that African countries do their homework on researching their own local impact of climate change. Adaptations are much related to the capacity of a country to develop. At least the state should have plans for sustainable development, that plan should be able to assess the impact and risks related to climate change (World Bank, 2010).

It is true that where natural resources are involved there are always conflicts. In conflicts there are winners and losers, this equally applies even in adaptation processes. There will be those who lose due to their high levels of inability to cope and there will also be those who win due to their high levels of capacity to adapt.

For example, IPCC (2009), suggests commitment to international trade that will enable developing countries to participate with developed countries to sustain food security globally, it is not surprising to learn from Zoellick (2010) and Ringler et al. (2011), that in some countries such as Nigeria, Zambia, Mozambique, Zimbabwe etc, there have always been obstacles in relation to implementing global liberal trade policies due to the fact that instead of improving agriculture in these countries through foreign trade, there has been proliferation of cheap food products such as wheat, oil, rice, vegetables, chicken, sugar etc. This happened at the detriment of African farmers. This shows the abuse of international policies by some developed countries that hold African countries at ransom.

More adaptations from Africa are still old strategies that people used decades ago and most groups such as farmers, fishers, coastal settlers and rural communities still rely on their own indigenous methods of adaptation, even if they are no longer working due to changes in climate variances, but because their governments have not found proper ways of facilitating new ways of adapting to climate change through technology, information systems and training and development (James, 2015).

For instance, the research conducted in rural areas by Mashingo (2010), Maponya (2012) and Mallikarjuna (2013), shows that most farmers in rural areas still prefer to use their indigenous farming methods. They still prefer their traditional crops and livestock as they believe that they are more resistant to their local environment than the new breeds. However since they realise their vulnerability, they are gradually integrating them with the modern ones.

In Botswana, as indicated by Kumar (2012), farmers prefer to use their own compost as natural fertilizer as it is more affordable than chemical fertilizers. They do genetic modification of crops to create drought resistant high yield to sustain food production. Adin (2010) also highlights that modifying agricultural practices has helped many farmers from Botswana and Namibia, to cope with the effects of climate change. In addition to that, Keane (2009) shares that farmers in Burkina Faso do pits in the soil to collect organic material blown by the wind during the dry season, and add animal organic matter bury them together after the rainy season. They dig up the fertile manure and spread across their fields to fertilize the land. For them, that is a better adaptation option than using chemicals in the soil, which also increases the emission of greenhouse gases.

According to Brown (2009), in the midst of the impacts of climate change that has affected agriculture so badly, some farmers are left with no choice but to diversify their livelihood for survival. Aganga et al.

(2010) agree that in Botswana most farmers after losing their crop yield to droughts, they engage in some off-farm activities as a way of making an income.

This is supported by Mclean (2009) that some men and young people in Tanzania left farming for other economic activities such as establishing motorcycle driving businesses, selling oil and petrol, establishing hair care saloons etc. Food security is everybody's business, therefore individuals and their households, together with their communities and government should ensure adaptation to climate change in order to sustain food security.

According to IPCC, (2009) there was an effort on the part of United Nations (UN) to enable African countries to identify their immediate priorities in order to receive funding. Most countries submitted their priorities and plans to adapt in order for the UNFCCC to assist them on the following Priority Projects:

1. Improved water management for drinking and agriculture through understanding water flows, water quality, improved rainwater harvesting, diversification of irrigation techniques, and water storage to ensure availability of water to communities.
2. Improved climate and weather forecasting to assist farmers to notice and prepare for extreme events and disaster management.
3. Improved health care by building and promoting flood shelters and assistance shelters as part of community emergencies preparedness program, better health education, better access to primary health care such as distribution of mosquito nets, and better malaria surveillance programmes.
4. Mainstreaming of climate change capacity building into sectoral development plans, involving local communities in identifying adequate adaptation activities, raising public awareness and education and open for appropriate representation in international meetings.
5. Promotion of sustainable tourism, by improving ecosystem, hospitality, leisure and recreation.
6. Better land use management by proper execution of soil erosion prevention and control strategies, soil conservation measures, agro forestry and forestry techniques, veld and forest fire management.
7. Finding other alternatives of producing energy in order to augment and shift from the use of wood, paraffin and charcoal for domestic use.
8. Introduction of climate resilient crops such as indigenous crops and livestock, encourage and promote crop diversification, developing and introducing new breeds and species of plants and animals that would be resistant to floods and droughts, and improving fisheries breeding and livestock breeding as well as diversifying farming techniques in order to improve food security.

According to IPCC (2015), these priority adaptation projects are already funded in other countries that have shown commitment to the agreements made by the Convention. Food and Agricultural Organization (FAO) is one international organization that facilitates the implementation of these priorities by providing

capacity building, to assess risks and options to adapt to drought, floods, health risks and adaptation to climate change.

In reality, to ensure that the impact of climate change is managed well by developing countries, all levels of people should be involved to have a clear and realistic forecast of climate change at all levels, so that adaptations are mainstreamed from local level to global level, indicated by Chambwera (2010) when he categorized the different levels and gave examples to their needs in order to attempt successful climate change adaptations.

Mmamoto (2012) recommended the following adaptation measures for African countries and of course with the understanding that different countries will be affected differently by the impacts of climate change and different adaptation options will not necessarily work in different areas.

Africa recommended adaptation measures.

- Conservation and restoration of vegetable cover in degraded and mountain areas.
- Community based management programs for forests, rangelands and national parks.
- Adoption of traditional methods of natural forest conservation and food use
- Cross breeding zero grazing and acquisition of smaller livestock e.g. sheep and goats.
- Reduction of overall livestock numbers through sale and slaughter.

4.10 NATIONAL ADAPTATION PROGRAMME OF ACTION (NAPA)

It is evident that given the experiences of African states, as far as our changing climate is concerned, there is an urgent need to effectively adapt in order to cope with the impact of climate change. It is acceptable that since human and financial resources are identified as a major barrier to effective adaptation, it is only fair that the issue is elevated to the global discussion and decision taken internationally to assist developing states. UNFCCC and its meetings agreed that developing countries be assisted and several International and Regional Organizations have taken part in assistance programmes. Developing countries are also expected to identify their immediate adaptation priorities for National Adaptation Programme of Action (NAPA).

4.11 FUNDING FOR ADAPTATION

The agreement by the Parties and the UNFCCC is that all countries, rich and poor, adapt to climate change. Although it has been proven to be a costly exercise, plans need to be made to prioritize developing countries. It was also agreed that more funding would be required and sustainable financing of adaptation. To ensure that financial assistance is done adequately and properly, the convention appointed Global Environmental Facility (GEF) as an operating entity to manage its financial mechanisms. GEF

coordinates the transfer of funds from developed states to developing countries, in line with the applied funding of programmes.

It works with implementing agencies such as the United Nations Development Programme (UNDP), United Nations Environmental Programme (UNEP) and the World Bank. Theirs is to assist developing countries to design and implement adaptation projects (GEF, 2009; UNFCCC, 2007).

4.11.1 Special Climate Change Fund (SCCF)

According to UNFCCC (2007), based on the funding guidelines GEF, runs other three trust funds, namely the Special Climate Change Fund (SCCF), which was created to complement other funding mechanisms. It finances projects and programmes that relate to capacity building, technology transfer, adaptation, climate mitigation and economic growth strategies of countries depending on income from fossil fuels.

Table 4.2 Napa adaptation Projects for funding

	NAPA PRIORITY ADAPTATION PROJECTS
1.	Improved forecasting for farming, extreme events and disaster management
2.	Improved water management for drinking and agriculture through understanding water flows and water quality, improved rainwater harvesting, water storage, and diversification of irrigation techniques.
3.	Improved food security through crop diversification, developing and introducing drought, flood and saline-tolerant crops, improving livestock and fisheries breeding and farming techniques, developing local food banks for people and livestock.
4.	Better land and land use management through erosion control and soil conservation measures, agroforestry and forestry techniques, forest fire management and finding alternative energy sources to wood and charcoal.
5.	Improved health care through floods shelters and assistance shelters as part of community emergency preparedness programme, better health care such as distribution of mosquito nets, and better Malaria surveillance programmes.
6.	Capacity building to mainstream climate change into sectoral development plans, involving local and communities in adaptation activities, raising public awareness and education. Enable representation in international meetings.
7.	Promotion of sustainable tourism.

Source: UNFCCC, 2007

Secondly, a Least Development Countries Fund (LDCF), a fund established to support a special work programme to assist the Least Developed Countries (LDC). Lastly, Adaptation Fund, under the Kyoto Protocol that finances practical adaptation projects and programmes in developing countries and support

capacity building activities. It is funded from the adaptation levy of 2% on Clean Development Mechanism (CDM) projects (UNFCCC, 2007).

Also listed amongst the response programmes is the Nairobi Work Programme (NWP), which is established to help all Parties, especially the developing countries, LDC's and small island developing states to fully understand and improve their assessment of implications of climate change. Their role is to ensure that Parties make informed decisions on practical adaptations and respond well with scientific, technical and socio-economic support needed (UNFCCC, 2010; Cassie, 2014).

4.11 SUMMARY

Chapter three introduced the impact of climate change and characterized it according to effects, namely, (a) changing weather patterns, which comprised of rising temperatures, unreliable and unpredictable rainfall patterns, (b) precipitation which comprises of storms, hail and sleet, (c) extreme weather which includes floods, droughts and heat waves. These effects are further explained with focus to their relationship to the impact of climate change.

This chapter three deals with the impact of climate change in Africa. It highlights Africa's experience with (a) shortage of water in Africa, which affects most of African countries. It explains how shortage of water has contributed to the reduction in production yield in most countries. In some countries, in particular those who share the water sources, this has sparked conflicts.

The situation of Lake Chad, where many rivers from different countries flow, has also been discussed. It has been clarified also that in most countries shortage of water could be as a result of the countries' inability to manage water resources and lack of proper water infrastructure. However, there are also proposed adaptation strategies to the impact of rising temperatures and irregular rainfall patterns, droughts and floods in Africa.

This section highlights the impact of climate change in agriculture. It provides the evidence from different countries that even though climate change is a threat to Africa's food production, Africa is still determined to produce food with whatever they have. In most countries agriculture is predominately done by small scale farmers, who due to their economic status, have created their own adaptation strategies in order to deal with the impact of climate change in their own local areas. This is regarded as commitment toward ensuring sustainable food security.

The impact of climate change on human health poses a threat for Africa's population. It is discussed in this section, how climate change affects food production which reflects reduced yield and which ultimately affects the availability of food. When there is less food available people suffer different kinds

of diseases. It also expresses that many human diseases come with climatic changes and the pollution itself.

Africa has been attacked by air-borne diseases such as asthma, water-borne diseases such as diarrhoea and vector-borne diseases such as malaria. These diseases in many countries are difficult to contain due to poor health services, systems and infrastructure in most countries. The study has learned that more needs to be done to support comprehensive rural development plans in different countries that will ensure Africa's development is accelerated to allow for a healthy environment.

The section highlights international legal framework that has been developed by countries over the world in order to accelerate their fight against the increasing emission of greenhouse gases. The establishment of the United Nations Framework Convention on Climate Change (UNFCCC) has been discussed together with its efforts at combating and adapting to climate change and its impact globally.

International policy responses are also discussed, the Paris agreement in which countries agreed to undertake dealing with climate change, which led to the setting up of the following goals, (a) Long-term temperature reduction goals, (b) global peaking, (c) mitigation, (d) sinks and reservoirs, adaptation, (e) finance, (f) technology and capacity building, (g) and global stock taking.

Africa's responses have also been discussed in this section and Africa's Adaptation Programme initiated by United Nations Development Programme (UNDP) in order to assist African countries with strategies to adapt to the impact of climate change. The regional organisations such as NEPAD, South African Development Countries (SADC) and Economic Community of West African States (ECOWAS) have also created programmes to assist their member states to curb the impact of climate change. African Union (AU) on the other hand has established Comprehensive African Agricultural Development Programme (CAADP), to assist African farmers to work towards sustainable agriculture.

This chapter expressed African countries' frustrations about the impact of climate change and exposed the adaptation strategies that farmers in different African countries have adopted. From different countries the following adaptation strategies were deduced, (a) water and water resource management, (b) livelihood diversification, (c) soil conservation, (d) irrigation, (e) immigration, (d) Crop diversification, (e) livestock diversification, (f) use of natural fertilizer, (g) genetic modification of breeds, and (h) modification of agricultural practices.

This is an indication that even when their effective strategies are not that effective, the commitment they have in food production would need the relevant authorities to consider investing in them for finance, technology and capacity building to equip them to better adapt to climate change.

This chapter also highlights the commitment of the United Nations (UN) to assist Africa to deal with climate change and its impact. The climate change priority projects conducted by UN in Africa are also discussed. They include, (a) the improved water management, (b) improved climate and weather forecasting, (c) improved health care, (d) mainstreaming of climate change capacity building in programmes, (e) promotion of sustainable tourism, and (f) improved land use.

The chapter is completed by clarifying options available for African countries to access funding for implementing the proposed climate change adaptation strategies and climate change priority projects in Africa through the Special Climate Change Fund.

CHAPTER FIVE

THE STATUS OF FOOD INSECURITY IN SOUTH AFRICA IN GENERAL

5.1 INTRODUCTION

Food insecurity is a global threat to human existence and majority of developing countries are vulnerable to food insecurity. South Africa is one of those countries that have the majority of poor people who cannot afford to access food on daily basis. It also gives assurance to its citizens through the South African Constitutional Law of 1996, which has right the to sufficient food and water; and social security engraved in its bill of rights. To achieve food security, South Africa needs to achieve household food security first.

Figure 5.1 Map of South African Provinces



Source: StatsSA, 2013

Food and Agricultural Organisation (FAO) (2014) has reported that 814 million people are undernourished globally and about 204 live in Africa, South Africans included. Despite its economic advances, South Africa has made poverty, unemployment and recent global melt down influenced food

price, fuel and electricity hikes. The situation has put pressure on poor people who are mostly rural communities.

Globally, food security is achieved when all people at all times have enough food for active healthy living. It puts emphasis on the availability and accessibility of nutritious food. The interpretation is therefore that all people should be able to buy food or produce food for them and still be able to purchase food of their choices according to their dietary requirements. There should be no beggars and scavengers and stealing of food in a food secured world.

On the contrary, food insecurity happens when food is not easily available and accessible to people and they cannot even secure enough. Even when food is available in the market they are not able to access it due to its high prices. Therefore the implication would be that not all households afford to buy nutritious food, enough quantities and quality that is enough for all household members for every meal every day.

According to Human Science Research Council (HSRC) (2014), South Africa's food trends are categorised by those who are food secured, those who are at risk of hunger, and those who experience hunger on daily basis. The situation of South Africa is such that 26% of the population is experiencing hunger and 28.6% are living at hunger risk, and only 45.6% are considered food secured. The Provinces of Eastern Cape and Limpopo are leading with highest numbers of citizens that are food insecure.

Statistics South Africa (Stats SA) (2016) also showed that challenges of food security are such that they cannot be isolated from poverty status of the country, in other words, for South Africa, food insecurity is not a onetime event, but it is a process associated and influenced by so many other factors such as the economy, climate change, and good governance. It is already a fact that more South Africans buy their own food instead of producing them, and with challenges such as low levels of employment in the country it means many people without income will eventually get to the risk of hunger mode.

For the majority of people who fall in the poor bracket, they are either unemployed or their main source of income is small piece jobs with little and unreliable income, some depend on the social grants that the government offers as old age pensions and child support grants. Literally, some depend on transfers and borrowing from working relatives and neighbours to survive. Although some have entitlements such as land to enable them to feed themselves, lack of resources and climate change are their major challenges.

In South Africa there is a thin line between food insecurity and poverty. Poverty decides for most people the ability they have in shaping their livelihoods. Poor people are not able to develop their livelihood strategies that will ensure that they have a long term coping mechanism. According to Department of Agriculture, Forestry and Fisheries (DAFF) (2015), the majority of people who are vulnerable to food insecurity are poor people without land, capital and tools, education, entitlements and any form of skill. This is a group of people who earn very little and maintain more people.

There is also another group of people who are socially disadvantaged because of gender (women), age (elderly people and children), and the disabled people who cannot do most to the work by themselves. These groups share common characteristics as listed below.

- Children under the age of five are vulnerable to malnutrition and infectious diseases, such as cholera, Diarrhea, polio and other diseases caused by under nutrition.
- People living with disabilities do not have equal opportunities of producing their own food and they always suffer exclusion in most projects, such as the Expanded Public Works Programme (EPWP) projects.
- Most families have people who are either infected or affected by chronic diseases such as HIV/AIDS, Cancer, Tuberculosis, malaria and diabetic. These people have special diets and medication. With the rate of unemployment in the country most people struggle to get adequate medical attention and food preferences according to their type of diseases.
- Most women who are divorced or widowed struggle to make ends meet after the loss of their spouses who have been the breadwinner and this is influenced by low levels of payments among women and loss of access to rights to property in some cases land.
- Areas that are in the remote rural areas mostly are vulnerable to the underdevelopment and lack of proper services in their areas. They are forced to travel to towns and cities to get access to better services, such as medical services, schools and markets. They spend a lot of money on transport costs. They are also disadvantaged by their lack of information for most of the opportunities enjoyed by people living in urban areas.

Although these two groups that share common characteristics they differ in their vulnerability due to household demographics and the way food is distributed in each household. Most rural areas in South Africa share the sentiments of Sekhukhune, the poverty stricken village in Limpopo Province, where it was discovered that food insecurity is caused by escalating food prices where more people are unemployed and cannot afford to buy their own food.

Majority of the people who used to produce their own food, have stopped due to the effects of climate change that has changed the fertility of arable land. Most farmers have diversified their income and looked for jobs due to low and costly yield. Majority of people depend on the wages and remittances and therefore they are not even able to save; they live from hand to mouth. Even after 20 years of democracy, South Africans still live in poverty. Most strategies employed internationally, like the Millennium Development Goals, put the eradication of poverty and hunger at the top of their list, but this could not save South Africans.

It has been found that other factors contributing to the food insecurity situation of South African households include increase in the cost of electricity and oil prices. These regular increases in prices

result in higher prices of food, fertilizers, and cost of transport. There is evidence that lack of purchasing power leads to food insecurity. Poverty and food security have accelerated the spread of HIV/AIDS, by taking livelihood household assets and livelihood of affected households. This therefore contributes to household food insecurity by leaving the household impoverished and vulnerable. From the policy point of view, research acknowledges that the problem of food insecurity in South Africa is partly due to demographic factors of race, family size, occupation and gender of household heads (Zunckel, 2009).

5.2 CLIMATE CHANGE AND ITS IMPACT ON SOUTH AFRICA

South Africa is not immune to the devastating impact of climate change in all sectors of its economy, in particular agriculture and water resources. The location of South Africa makes it more vulnerable, as it is situated in the mid-latitudes and semi-arid region, so the rising temperatures and irregular and unpredicted rainfall patterns are also projected. The predictions done by Du Plessis et al. (2010) for South Africa indicates that night time temperatures will escalate more than day time temperature, meaning that the temperature will rise. In addition, minimum temperatures in winter are likely to increase more than maximum temperatures in summer. These temperatures are likely to bring more floods, heat waves and droughts (Joubert, 2008).

According to Department of Environmental Affairs (DEA) (2014), there will be long periods of dry weather followed by severe storms that will come regularly. The increased periods of drought and rising temperatures will be responsible for the shortage of water supply. This will increase water demand and water stress. Water reserves are also likely to be affected by these unpredictable conditions. Du Plessis et al. (2010) mention that the quality of water flowing into the rivers, streams and ground water will be affected and the level of runoff will decrease.

It is against these projections that Bates et al. (2008), present the impact of climate change to South as a haunting issue due to the fact that the population is growing and the demand for food and water is also increasing in an alarming rate. The study will focus on the three aspects of the impact of climate change on water, agriculture, food security and health.

5.2.1 Climate change impact on water in South Africa

South Africa is generally a water scarce country. According to usage trends, water demand is likely to be higher than the available water by 2025. This is due to industrialization and urbanisation and climate change which has come with extreme weather events that have put more pressure on the country's water supply (Department of Water Affairs (DWA), 2015)

The challenge that all the provinces face is limited water resources and uneven distribution of available water. This creates a situation where those who are wealthy and staying in urban areas are less vulnerable

to water shortage and the vulnerable poor from rural communities suffer the most (Maponya, 2012). However, the current situation of South Africa seems to be telling a different story.

For example, Cape Town as one of South Africa's big cities in the Western Cape Province, is struggling with water due to the poor rainfall that has led to a severe drought. The demand for water that is shared by industries and agriculture has grown to a point of where the supply is at a very critical point. According to Western Cape Government (2017), Cape Town does not have water storage project currently; it has relied on its 44 dams for water supply. Currently all dams collectively hold only 1870.4 million cubic meters. Many dams have recorded drastically low levels of water. They have dropped to 30 % which is far less than 40% that was recorded this time last year. The situation is so bad that Cape Town City Municipality has put water restrictions to use.

A similar situation has been reported in Gauteng as well. Gauteng is supplied with water by Vaal River, which has been reported to be running very low. It is supported by several reservoirs, which include Lenasia high level and Alexander Park reservoir. Due to factors such as climate change and population growth of the big city, the supply of water is very much threatened. Gauteng has also been on water restrictions lately due to shortage of clean water, as the dams that supply the whole province with water were becoming far below average (South African Weather Services (SAWS), 2015).

Without water, many sectors cannot function as they rely on it one way or the other. However, many of the provinces who engage in sectors such as mining should also begin to strategise on the proper water controls and use water sparingly. In the North West Province of South Africa, government needs to re-evaluate their water restriction on the mining and irrigation industries. While the economy is growing in this province due to mining and agriculture, more rural communities are left with shortage of clean water.

According to Neves and Dutoit (2013), most provinces would find it difficult to invest in farming if food production is threatened by shortage of water. This is because water and agriculture experience the direct impact of climate change due to their direct exposure to and reliance on weather conditions. It is therefore important for South Africa to assess the impact of climate change on such sectors to act proactively to minimise the impact and to plan appropriately for the long-term adaptations.

Flooding and droughts constitute major water-mediated impact of climate change that needs to be planned for from household level to national level. The overall impact is unpredictable and it affects provinces differently. Western Cape, Limpopo and North West have been reported to be severe water hotspot in as far as water is concerned. It is equally important for all provinces to understand the possible impact of climate change on water resources in order to ensure that it is appropriately managed and wisely utilized (Department of Water Affairs (DWA), 2015).

5.2.2 Climate change impact on agriculture

South Africa's agriculture is divided into commercial and small-holder/ subsistence farmers. These farmers are negatively affected by the impact of climate change. Farmers need good climate to determine potential farming that is suitable for their areas across the country especially small holding and homestead setups.

Projected climate change for South Africa shows that temperatures are likely to rise and rainfall is also likely to fall sparingly across the country. Extreme weather events such as droughts and floods are likely to frustrate agriculture in South Africa. These are expected to affect both commercial and small holder farmers; however, commercial farmers will be at an advantage as they have more capacity to adapt to the impact of climate change than small holder farmers.

Climate change will affect crop production through high temperatures and reduced rainfall. High value export agricultural production will also be affected by this poor performance. Crop production is the main food source for rural communities, it influences the availability of food. Intensive animal husbandry practices will also be affected by high temperatures, heat waves, floods and droughts as well. Poor food production generally has unbearable consequences for vulnerable poor people living in South Africa. The implication is also felt with the high and escalating food prices, which are influenced and affected by many other factors causing the impacts of climate change.

With the current climate scenario, reduced production of staple food such as maize is a real set back to the people of South Africa, because many who depend on maize as a staple food, will be affected by shortage and escalating prices of maize products. It has also been reported that the production of maize has declined, which also affects the markets and job creation for many commercial maize processed products. Agriculture is a major employer of rural communities. They cannot afford to lose jobs at a time when they cannot even afford to produce food for themselves. This, according to Madzwamuse (2012) will force people to more drought-resistant crops or consider genetically modified food for survival.

According to Modiba (2011), the excessive rainfall in January and February 2011, resulted in the loss of dry grapes and wine in the Northern Cape, and made people realise that they really need to appropriately and proactively plan for climate change. It is important for farmers to have information about climate change and rely on weather forecasting to help them to protect their production against the effects of climate change.

Livestock industry is also a major source of food in South Africa that provides meat and milk products. Livestock is also used for many other purposes such as exchange for goods or services, transport, for paying lobola and for ritual purposes. With climate change high temperatures, floods and droughts, animal production is threatened. Farmers in the North West lost their livestock to drought that took place

during 2012/2013. Small scale farmers who own livestock in villages predominantly own less than 20 heads of livestock each. Most of the farmers still have not recovered from that loss, even though the Department of Agriculture provided the livestock farmers with feed to assist, but it was not enough and most of them had already lost their animals.

According to DAFF (2011), livestock in South Africa has been mostly reduced by drought and distress sales. The commercial farmers in the country often have cash reserve to buy feed, maintain water dams, and afford to sustain their production even during extreme weather events. Mandleni (2011) supports that by stating that small scale famers do not have capital and their livestock suffer until they die. Most of them cannot even save them by selling them to recover the money as they are not sellable due to them losing quality and good health.

There should be strategies to enable farmers to cope with the impact of climate change. Farmers, government, private sector and other relevant stakeholders have to device some means to assist small scale farmers in South Africa to adapt to the effects of climate change in order to promote sustainable food production.



5.2.3 Impact of climate change on food security in South Africa

When agriculture is negatively affected by the effects of climate change, the whole food chain suffers. Beginning with reduced rainfall and high temperatures that influence the failure of crop production, to failure to process enough food crops, or failure to deliver food to other areas due to floods, all these impact the availability of food in the market. For instance, in a good maize yield, South Africa knows food security is quaranteed, but when the yield of maize as a staple food is reduced, due to of climate change, it means that food security is in danger.

According to National Development Agency (NDA) (2014), poverty and unemployment make it impossible for most families in rural areas to buy food other than the crops they produce. Food security is also caused by reduced land for arable land, and the unreliably shortened growing seasons that increase crop failure. When crops fail, it means farmers do not have food and do not have money to buy. This exposes them to other challenges brought about by climate change such as disease.

When less people have less access to food due to climate change, it becomes difficult to quarantee their health status. With the shortage of health facilities that South Africa is faced with, it means that those with chronic diseases or vector borne diseases, even HIV/AIDS will not survive as they need to subscribe to certain diets. The truth is that when climate change has negatively impacted food production, it is not possible to achieve food security; however, with proper and appropriate adaptation strategies to manage the effects of climate change, food security can be achieved in South Africa.

5.2.4 Impact of climate change on health in South Africa

It is necessary for the natural greenhouse gases to maintain their constant temperatures in a habitable manner on earth. Lately, the increase in emission of these greenhouse gases contaminated the atmosphere leading to the far warming temperatures, changing rainfall patterns causing incidents of extreme weather events, such as droughts and floods. These changes have significant implications on the quality of life and human health.

Langba (2014), expresses how increasing temperatures have direct effect on nausea, heatstroke, headaches and other cardiovascular diseases which can lead to death. However, many people in South Africa still do not take this serious even though announcements are made on South African radios, to caution people about heat waves and abnormal temperatures.

According to Du Toit (2014), poor air quality due to climate change has the potential to aggravate eye infections and irritations, acute respiratory infections, chronic respiratory diseases such as tuberculosis and death. This is very common in industrial areas and mining areas. For example people living in Sasolburg, in the Free State, have made claims to the Sasol Company for compensation on the pollution of their air quality. Most people in the area die to air-borne diseases due to the polluted air from the company (Zewdie, 2014).

High temperatures may lead to shortage of water which influences the quality of water. This may increase water-borne diseases (Christensen, 2009), and most rural areas and squatter camps in South Africa do not have running water. Lack of water supply and poor sanitation influence the spread of water-borne diseases such as diarrhoea and cholera. Transmission of cholera is linked to rainfall and temperatures and is likely to be affected by climate change. Many other communicable diseases are spread by rainfall, temperature and wind.

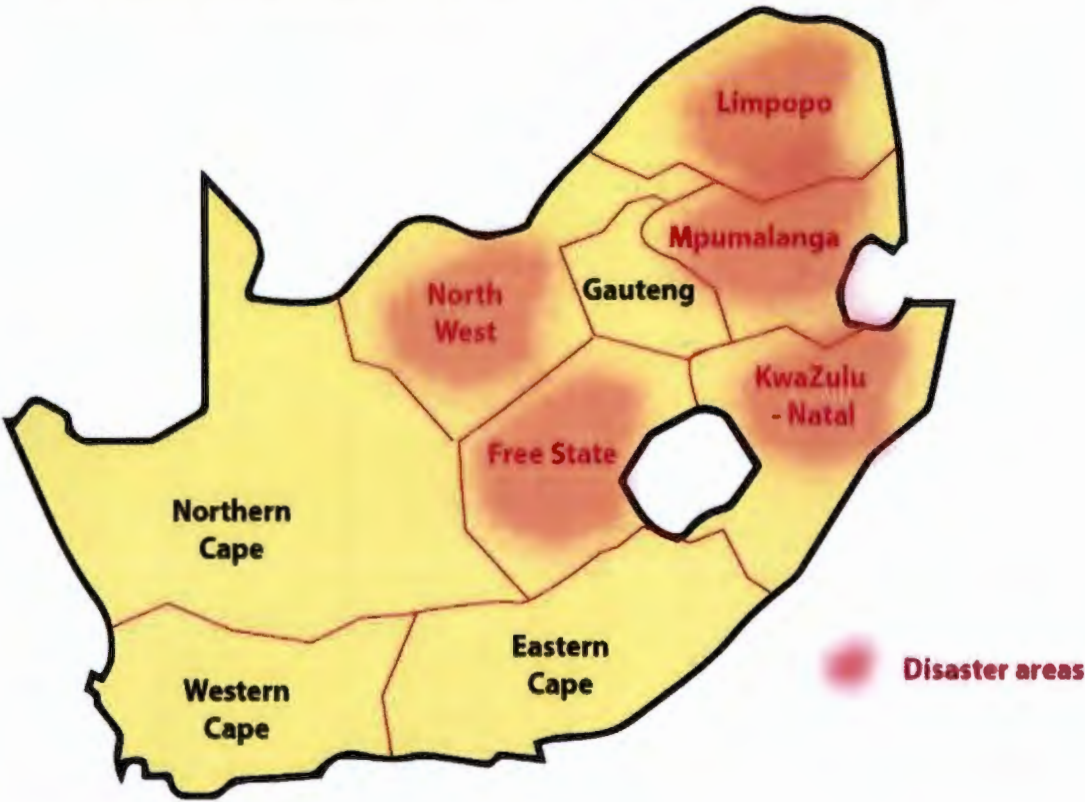
Poor health in South Africa is caused by many social issues that affect people's vulnerability and resistance to a changing climate (WHO, 2011). For example, unemployment, poverty, inequality, hazardous living condition increase vulnerability to weather extreme events, food insecurity, declining food quality and altered disease distribution.

Smith et al. (2014) maintain that it is crucial to mention that even though climate change affects everybody in South Africa, but the vulnerable will be those who live in communities and residing where there is shortage of health care facilities. It is therefore important for individuals, communities and authorities to understand the current impacts of climate change, and decrease vulnerability and mitigate the health impact of climate change.

As indicated in Figure 3.1 below, even though South Africa is still nursing the wounds of severe droughts that took place in the past five years, not all the provinces were affected. Provinces such as the Northern Cape, Eastern Cape, Gauteng and the Western Cape were not affected. However, the remaining five provinces namely, Limpopo, Mpumalanga, North West, Kwazulu-Natal and Free State were hit by severe droughts.

Figure 5. 2 Areas affected by Drought in South Africa.

Areas affected by drought in South Africa



Infographic: Nathi Ngubane

Source: www.droughtsa.org.sa

5.3 ADAPTATIONS IN SOUTH AFRICA

To manage the impact of climate change in agriculture, Department of Agriculture, Forestry and Fisheries (DAFF) (2015), encourages farmers to invest in drought-resistant species of plants and animals as a strategy to cope with climate change. Adger (2009), also shows that diversification of crops and livestock is a working strategy to the effects of climate change. In some areas, people engage in reforestation in order to cover the land surface so that it is not exposed to the direct sun and or be destroyed by heavy rains through soil erosion.

The coastal areas in South Africa use fish as source of food, in particular, the source of protein, therefore they try by all means to protect the existence of fish species in their rivers, dams and oceans. The adaptation measure to save fishery includes using small manageable ponds to breed fish. Another strategy is to reduce waste that goes into the rivers, dams and lakes and contaminate water with harmful material. This has already destroyed many fish species in different areas (Cinner et al. 2012).

According to Thompson et al. (2010) tourism and leisure is one of the pillars of the economy in the coastal areas of South Africa. It is an industry that needs sustenance as it also plays a big role in enhancing economic development in coastal towns. It has the potential to generate jobs and increase revenue in South Africa. To ensure that they do not lose these benefits through climate change, most areas opt to prioritize ecotourism based on their own livelihoods. For instance, when a tourist visits Durban, it is not only the beach that is enjoyable, but even the Zulu culture is displayed everywhere in town and around.

Climate change has a direct and indirect effect on human health. According to World Health Organisation (WHO) (2015), the development of early warning systems for droughts, floods and other extreme weather patterns should be done to assist the population to anticipate and stay prepared for the extreme events. This could be done by taking medical insurance to increase and improve health services. Advocacy on the prevention of the transmission of water-borne and vector-borne diseases, e.g the use of protective nets for mosquitoes to protect people from Malaria infections and Dengue fever, can be encouraged..

5.4 LIVELIHOODS IN SOUTH AFRICA

Majority of South Africans live in poverty (De Klerk et al., 2014). The country is divided into urban and rural areas, where urban areas enjoy more development, economic growth and basic services than rural areas. This is inherited from the apartheid government where there was disparity between black and whites and this has continued into disparity between rural and urban (De Klerk et al. 2014; Du Toit, 2009).

The country has one of the highest unemployment rates in the world, with more than 13.8 million people living without regular meals. This is proven by the number of about 14 000 service delivery protests that took place in 2015 due to unemployment, hunger, rising food prices, fuel and electricity. These were voices of people who were showing their frustration, anger, intolerance and resentment to their living conditions (Neves and DuToit, 2013).

Even though the majority of people living in South Africa are living in poverty, black people are in the majority. Poverty levels are lower when it comes to Indians, coloured and a minority of whites living in South Africa. The income inequality and poverty trends still widens even decades after apartheid in South Africa (Neves and Du Toit, 2013). The effects of Apartheid are still being felt today by all people

living in South Africa. Its policies that encouraged capital-intensive activities, especially in industries such as mining, agriculture and manufacturing, still haunt South Africans even today (Mpandeli, 2012).

This was evident in 2013 during the Marikana Massacre where only black labourers died due to the labour strike. The legacy of apartheid in the mining industry has been that whites remain in positions of authority and power, while blacks were limited to being labourers with lack of mobility and training to enable them to grow within the industry. This perpetuated the abnormal hierarchy of leadership and management where black people were only limited to low levels and this negatively affected their growth and influenced the levels of poverty for the majority of black mine labourers households (Puttergrill et al. 2011).

In the agricultural sector, commercial farmers have always been white farmers and black farmers were only small-scale rural farmers and farm workers. With the imbalances in the organisation of employment opportunities in the country, the implication has always been that when the economy declines, only the majority of black people are affected by retrenchment because they form the majority of the semi-skilled and unskilled labourers.

Currently, South Africa is even in the worse position due to its democratic laws that allow even the migrant labourers to be part of its labour market. This has let the unemployment rate for South Africans to increase. Foreign investors are also conformable to employ migrant cheap labour. Factors such as population size, race, gender, level of education, occupational and geographical distribution of labour in the country have determined the supply of labour to the South African market.

With the characters of rural people of South Africa, it becomes very difficult to penetrate the labour market as a result the participation of whites, Indians and coloured in the labour market is higher than blacks even when they are in the majority and in political power (Stats SA, 2014).

Due to South Africa's big brother status to other Southern African countries, more migrants are flocking to South Africa, legally and illegally for better opportunities. This burdens South Africa that already is burdened by the effects of apartheid to cater for extra people from neighbouring countries. Above all lack of legal prescripts and policies to manage the movement of migrants in South Africa brings a challenge to regulate and control informal and unregulated labour recruitment, which further perpetuates risks of abuse and exploitation by the informal labour market.

According to Asghar (2011), most of the black population is congested in the former homelands. They depend on farming, migratory labour and social grants, with less development and employment and they are mostly under the traditional land tenure system.

The status is gradually changing due to the fact that rural people are beginning to move to urban areas even though the standard of living is higher; they have found a way of settling in illegal areas as squatters until government builds them houses. It is not that the government supports the emergence of this new trend of squatters, but it has also relieved most people coming from rural areas, who travelled long distance to come to work in the urban areas and spend most of their income on transport (Neves and DuToit, 2013).

Figure 5.3 South African Populations as 2011. Source: Stats SA, (2011)

	2001	2011
South Africa	44819705	51770560
Gauteng	9178873	12272263
Limpopo	4995462	5404868
North West	3193676	3509953
Northern Cape	991919	1145861
Free State	2706775	2745590
Mpumalanga	3365885	4039939
Kwazulu-Natal	9584129	10267300
Eastern Cape	6278651	6562053

According to Du Toit (2009), labour market regulations and laws of apartheid encouraged and enforced social and economic division of South African employment by gender, race and age, and the poor education system for black people has made more black people to be still struggling to break the barriers to economic opportunities. The democratic government in 1994 also came with new legislation and established institutions that were meant to address these disparities, but to a larger extent the registered progress has not been felt by half of the population. Those who own institutions and those in charge of the economy still have a great influence in the employment practices in spite of the set employment regulations and laws.

This is more evident in the agricultural sector that employs more semi-skilled and unskilled rural people. For instance, one commercial crop farmer who employs about 50 unskilled labourers to work on his fields permanently and seasonally, may decide one day that he wants to diversify his business and start game farming. It is up to him to retrench more than half of those employees and keep the number that he would need. This is not about employment only; it is also about shelter in the farm. He may risk evicting them in

his farm and rather facing in legal battles only if the evicted labourers have the capacity to take the matter up, which is mostly unlikely.

Table 5.1 Comparative Unemployment rate in South Africa

Province	Unemployment Rate
Limpopo	19.3
Kwazulu Natal	20.3
Western Cape	22.2
North West	25
Eastern Cape	26.9
Gauteng	26.9
Free State	27.9
Mpumalanga	30.8
Northern Cape	31.3

By Stats SA (2011).

Due to the prevalence of poverty in rural areas, the majority of households have adapted diversification of livelihood as a strategy to cope even with limited resources. Household capacity to adapt differs due to assets and resources. Those who are educated and able to get employment, they are able to earn adequate salaries and wages to sustain their livelihoods. The problem lies where there is lack of education and unemployment in a household. The implication is that with the current shortage of food production due to climate change it becomes difficult for households because they need to buy food for their daily consumption. Even for those who earn less income, the bulk of their money goes to buying food that is highly priced.

The majority of rural communities are vulnerable to food insecurity because they do not have enough land to produce enough food for domestic and market supply. Most do not have access to the supply of water and this makes it even difficult for them to invest in farming even on small scale. Where households have breadwinners that are employed and bringing house income, the situation is not sustainable as it depends on the survival of the breadwinner. Death, retrenchment or poor health can easily bring sudden shock to the household.

5.5 ROLE OF AGRICULTURE IN SOUTH AFRICA

The role of agriculture in South Africa has always been in terms of food production, job creation and earning of foreign exchange. Research has shown that 70% of our agricultural output is used as intermediate products. It is therefore important to acknowledge the role played by both commercial and emerging farmers who contribute optimally to economic growth of South Africa (AGRISA, 2015).

The role of the sector as a provider of food is an issue on the table in many other countries in so far as food security is concerned. Most countries do an evaluation of whether agriculture is still producing enough even in the present climate change era, and some are even making plans to diversify their production with modified food. North West Province is ranked the second after Free State and they produce 27% and 44% respectively. Limpopo Province on the other hand has the lowest production of maize, which qualified them for the level of food security in the province (Stats SA, 2014).

Statistics South Africa has shown that a typical household in South Africa spends more than 70% of its food budget on meat, bread and cereals, milk, eggs and vegetables. If this is the case then, it cannot be safe to allow agriculture to go down, especially on day to-day staple food. More small-scale farmers are leaving farming due to low production of crops and livestock. This is due to the effects of climate change that perpetuates the shortage of water and infertile land (Greyling, 2012).

South Africa has been competing in the international market as a producer of crops such as maize and sorghum and fruits. As the population grows and the regimes change, the new government came with its new agricultural trade regulations, the country's food sufficiency dropped even though some foods were still exported to the international world but wheat was still imported from other countries. Fruits and grape producers still have their successful participation in the international market.

Liebenberg (2011) states that it is not only trade issue but the agricultural sector's participation in the economy is also dependent on other sectors such as economic development, transport and information and technology. For instance for the farmer's productivity to increase he needs a good investment on land and agricultural inputs, he needs proper roads and transport to distribute his produce cost effectively. So a normal household would be steep if the returns on the other hand are not good. As an employer, the sector employs around 700 000 workers and is regarded as one of the biggest sector that employs more semi-skilled and unskilled rural population (Grain SA, 2015).

According to Food and Agricultural Organisation (FAO) (2012), indicates that the production of cereals has not been able to meet domestic demands but maize still does. More meat products are imported and this result of more white meat being consumed particularly chicken. The sector maintained its ability to meet local demand on vegetables and fruits.

It is also supported by Statistics South Africa, (2012) that the failure of the agricultural sector to meet its local demand on main food items would make south African vulnerable to price increase. The majority of low-income workers may struggle to purchase food at high prices given that a bigger percentage of their income goes to food. It has also been indicated by FAO (2013), that increase in food price is not only as a result of production and demand of food for consumption but is also influenced by the rise of prices in oil, fuel and electricity.

Agriculture remains key to food security in South Africa. Poverty alleviation could succeed in reducing food prices, job creation, and improving family income and wages. Research has shown that if agriculture could be prioritised at community level, food insecurity could be reduced and economic growth increased.

When people are capacitated in producing their own food and proper use is made of their resources such as water and soil, instead of paving the whole yard, they could benefit from reducing their trips to markets to buy food and rather use the money they have on some other needs. Issues of malnutrition and impoverishment could be alleviated. Lessons from other countries have shown that small-scale farmers have potential to reduce food insecurity in rural communities. It has also been proven that with adequate farmer support programmes that prioritise them, they are able to alleviate poverty and livelihood opportunities also increase (DAFF, 2015).

Agricultural sector has a bigger share on employment and to strengthen this role agriculture job creation has been incorporated into the National Development Plan. This, however, raises some questions as the agricultural sector is declining despite the institutional efforts made. The truth is as development takes place there are more of other sectors that create employment and people change carriers, relocate and diversify their income into other sectors, as a result the agricultural employment declines. The other reason for the decline of employment in the sector maybe the low levels of wages paid compared to other sectors fighting for space in the economy (Greyling, 2012).

South African agriculture is divided into crop, livestock, forestry and fishery which all form food the production system. The sector is divided into commercial and subsistence farming. Commercial farmers engage in massive food production including exportation of food to other countries. This sector although also affected by climate change, it is unburdened by the fact that it affords to adapt to the impact of climate change.

The other sector produces food for subsistence and relies on their farming for livelihood. They do not enjoy the same benefits as commercial farmers as the sector is very under sourced and less organised, they depend on the assistance of government to improve and move to another level of production (Altman et al. 2009).

Historically, rural communities have been able to produce food for them but due to climate change and poverty they have turned more into consumers of food than producers. This negative implication has prompted them to diversify their livelihood into non-agricultural sources of income. This then frustrates the efforts of rebuilding agriculture for small-scale farmers in South Africa (DAFF, 2011).

The issue of land is a bone of contention in South Africa's political discussions. As an essential component of addressing food security in South Africa, it is difficult to discuss agriculture without land.

In addressing the disparities in the distribution of land, it is important to regard land when dealing with issues of agricultural contribution towards reducing food insecurity in the country.

Stats SA (2011) reports that 17.1 million hectares of land is owned by black people in South Africa. Only 26% of that land is suitable for agriculture. Although black people are in majority in South Africa, the majority reside in the rural areas, poor and food insecure. Although government and private sector are doing their best to close the gap in the economy, this area remains a sensitive unresolved threat to South African food security. Most land ownership is still under local government and traditional authority and this makes it difficult for rural farmers to qualify for financial loans due to lack of ownership to required land.

Many studies conducted concur that the agricultural sector is not the main player in the economy but is an important player in sustaining other sectors. The role of the agricultural sector is to produce enough and supply the domestic demand in order to prevent the vulnerability of having to depend on imports and rising food prices.

The Agricultural sector plays a role in enhancing other sectors in the economy. Its linkages with food retailers and beverages have enhanced the transfer of capital to other sectors. The role of the agricultural sector is to provide job creation and employment. Another role of agricultural sector is to enable growth of other sectors by providing them with food (DAFF, 2012).

There are lessons that can be learned from other regions and countries to improve on agricultural production in order to sustain food security. Throughout the world climate change awareness has gained momentum in all developing and developed countries. With the introduction of Climate Smart Agriculture (CSA), more farmers have begun to identify and copy best practices as forms of adaptation strategies.

According to FAO (2015), Climate Smart Agriculture (CSA) is a food production system that helps farmers to increase their capacity to adapt to climate change. They increase their yield, reduce emission to greenhouse gases and adopt effective adaptation strategies. This promotes and enhances food security and other rural developmental goals.

FAO has been very helpful in promoting Climate Smart Agriculture in most regions by distributing information through projects. The system has proven in some countries that some solutions for climate change are in the hands of the people affected. Climate Smart Agriculture provides practical methods to win food security in the midst of the changing climate.

For instance, when the organic manure is put into the soil through tillage, the crops become more resilient and gain holding water capacity. This also reduces the cost of having to buy fertilizers to increase soil

fertility. When this works well for farmers and increases their crop yield, they will be able to grow more under the same conditions and will have more returns in terms of profits. With more income their capacity will be well enhanced by the system (Parry et al., 2011).

Climate Smart Agriculture also prioritises land covering by addressing issues of land planning, agriculture, fisheries and forestry. It encourages farmers to use all solutions in order to resist climate change. Countries are encouraged to prioritise climate change in their policies and mainstream it in their programmes to ensure that food security production is increased and sustained. The programme covers the following countries, Kenya, Congo, Malawi, Lesotho, Mauritius, Namibia, Botswana, Mozambique, South Africa, Democratic Republic of Congo (DRC), Swaziland and Angola.

The ultimate goals of these countries are to achieve food security through sustainable food production and resilient communities towards climate change impact. Its aim is to cover 6 million small-scale farmers in terms of building capacity on climate smart agriculture practices, approaches and systems. Climate Smart Agriculture deals with small scale farmers, prioritising women given the bulk of the work they do in farming and ensuring that households have food at all times (Mubaya et al., 2011).

Based on the information that is provided by CSA Alliance, countries have reported good stories on the effectiveness of information resourced through the Alliance. Zambia and Malawi have followed the advice of prioritising and investing on improved effective institutional and policy capacity to support the initiative. Mixed farming and agricultural diversity have been used by Rwanda farmers to improve on their farming. Tanzania and Kenya farmers have used soil conservation practices and water management as their adaptation strategy (FAO, 2015).

About 25 African countries have launched Climate Smart Agriculture Alliance for Africa, which identifies areas of priority to pave way for good policy changes in order to invest on priority areas of adaptation. This is meant to enhance the efforts made by Africa to strengthen Agricultural production in Africa. The Alliance's intention is to empower as many African farmers as possible. Ethiopia, Niger and Zambia are the first countries to be used as pilot projects. That was decided on at the workshop that was held in Tanzania in 2014 on "Africa Agriculture in a changing climate – Enhancing the uptake of Climate Smart Agriculture as a solution to agricultural climate change issues."

5.6 CONTRIBUTION OF SMALL-SCALE FARMERS TO FOOD SECURITY

It is still surprising that in most parts of the world, commercial farmers dominate the farming business through the mainstream agricultural supply but still do not meet the global demand of food on their own. They cannot even create employment in that sector without the assistance of small-scale farmers. In most of the developing countries, more land is owned by small scale farmers, subsistence farmers or farming families, as a result most governments have begun to realise the important role played by small scale

farmers in reducing rural poverty, reduction of hunger and sustaining global food security when they are adequately supported.

Although there is still a debate on how to define small-scale farming, Maponya (2012), indicates that small-scale agriculture is when crops and livestock are produced on a piece of land without the use of advanced modern technology. Although small-scale farmers' definition is supposed to come from this statement, the debate is always about unclear and unspecified size of the land. This is due to the fact that there are different pieces of land used on backyard, on the family private farm, on a traditional land or on the urban open space. It also brings clarity to some to mention that this type of farming is very much labour intensive.

Animal traction is sometimes used in the absence of mechanisation; there is also limited use of agrochemicals for the crops. Small-scale farming is a source of household food security and income generation from the sales of surplus. It is also recommended by ecologists as only a small portion of land is cleared for cultivation, as a result the less use of fuel mechanisation used, the less emission than the commercial agriculture.

Economically, small-scale farmers promote local economy by creating jobs and providing local markets. It also promotes cohesiveness amongst the locals, as they tend to supply those who cannot afford food free of charge when there is a need. However, in most areas, small-scale farming is less practised due to different factors including lack of finance, limited resources and less interest due to the negative impact of the changing climate.

In his speech President Zuma (2012), reiterated, *"small scale farmers play an important role in supporting government's efforts to secure the country's food security."* While he also acknowledged that the decline in the productivity of small scale farmers in South Africa was because of insufficient government support through lack of rural development, infrastructure, finances and agricultural expertise, he also appreciated that their efforts even with limited resources are more visible in driving the promotion of food security and the growth of rural economy. The support and promotion of small-scale farmers has the potential to reduce urban migration and people's dependence to social grants.

It has been confirmed historically that most rural households produce their own food. Some recent studies and surveys have shown that that is no longer a case since more of small-scale farmers in rural areas are being pushed out of farming by the impact of climate change and their inability to adapt. Their reduction in yield and production has frustrated them and forced them to diversify their livelihoods. Currently, access to food in rural communities is through subsistence production, social grants and purchasing from the market. Majority of people living in rural areas are poor and do not have a buying power to purchase food.

Figure 5.4 Rural women inspecting crops in the communal garden at Malle Fresh Produce



By S.M Pheto, Malle Agricultural Projects, Rustenburg, 07 July, 2017

The majority of 4 million small-scale farmers in South Africa, who are supposed to be growing agriculture, engage in small scale farming as a source of food and purely for domestic use and as main income, but they lack resources to produce more. Research has also indicated that due to bigger number of small-scale farmers, some sort of assistance needs to be given by the state to improve and help them sustain food production in rural areas. As stated by respondents in this study, challenges faced by small-scale farmers are not adequately addressed by the current support offered by government because a drop in an ocean only enjoys support. This has somehow closed doors for innovative, committed farmers to move from small-scale farming to commercial and market-oriented production.

Figure 5.5 shows some of the agricultural labourers in rural areas who persist to work in communal gardens. They persevere because they survive out of the small income they make in the garden, but in essence they only afford the food they produce and not anything else. Being breadwinners, for most of them, life becomes more difficult when they have to use the little money they earn to buy expensive electricity, to buy children clothes, to make sure that they have decent homes with other assets that could later be converted to cash to buy food. The status of their life never changes as there are no developments in their areas and there are not even prospects of finding other jobs to diversity their livelihoods.

Research has shown that in other countries where government has given small-scale farmers adequate support, they have been able to reduce food insecurity. Malawi's Agricultural Input Support Programme

(AISP) managed to increase crop yield across staple food produced by small-scale farmers and has assisted them to cope with food price increases.

5.7 ROLE OF GOVERNMENT IN CURBING FOOD INSECURITY

Every government has a crucial role to play in order to achieve food security. It should provide a public service that leads to the development and enhancement of agricultural activities. Government should invest in the agricultural sector to increase food production nationally and internationally. Because agriculture cannot work in isolation from other sectors, government should have plans to integrate agriculture with other sectors such as transportation, energy infrastructure, Education and agricultural research, finance and trading etc. It is the role of government to make sure that these other related sectors have the legal best practice framework to encourage and get the private sector to invest.

It is also the duty of government to ensure that there is proper budgeting for agricultural activities, agricultural science, education, training and development, effective extension services and establish a favourable environment for efficient agricultural practices. Private sector should partner with government to ensure investment in critical sectors such as providing appropriate physical structures, transport, energy production and distribution and storage infrastructure.

Figure 5.5 Crop Production has provided jobs to many people from rural communities.



By S.M Pheto, Shomang Agricultural Cooperative, Ga- Matlala, Limpopo, 08 July 2017

The partnership should be visible in terms of promoting agricultural studies and research, agricultural finance in the form of loans and grants, agricultural technology and provision of agricultural implements and mechanization. Government has the responsibility to set up structures that would ensure proper governance conserving land rights, property rights, taxation of business and proper business law to encourage investment by the private sector. In that way agriculture will thrive and food security will be sustainable.

Government has a role to influence and set up internationally accepted food safety standards the movement and distribution of food can more harm to the health of the people if it is not regulated and standardized. Therefore, it is important for government that in ensuring the availability of food to its nation either through domestic produce or imports, there should be proper regulation of customs for imports as well as imported food to reduce food health risks. There are more fake products that are getting into the country illegally because they do not subscribe to the required standards, some of these items are foods that are smuggled in illegally and sold at a cheaper price. That is what the government should control.

It has been discussed in many studies that small-scale farmers make a huge contribution to food security. This group is responsible for feeding the nation and they need to be supported to expand their effort in ensuring food security. Small-scale farmers are mostly from impoverished communities with challenges of poverty, low levels of education and unemployment. They need to be supported by government, the private sector, civil society and academics. Because of their background they need to be trained and developed to perfect their skills and knowledge in agriculture in order for them to increase their production sustainably.

Most small-scale farmers are resource stricken and are unable to produce up to their ability and it is important for government to assist and facilitate investment of private sector to support them with finances either through loans or grants. In order to apply best agricultural practices, they need proper equipment and implements, without adequate financial support they are not able to achieve more. Small-scale farmers should receive revenue safety nets from government.

Small-scale farmers are leaving farming not because they want, but they are faced with the reality that with climate change hitting so hard, they work at a loss, as their yield is reduced and they can no longer keep up with the demand. In some cases even the quality of their products is at the standard that is not satisfactory to reach the market and in that way the prices also have to drop. Government therefore has to ensure that the small-scale farmers have access to crop insurance and manage can risk so that they can deal with crop failure due to extreme weather events and unreliable weather patterns.

Another burning issue for small-scale farmers is the issue of land. The majority of people living in rural areas do not own land and are not even able to use it as collateral even when they are required to do so by investors or funders. The land either belongs to government or tribal authority. Government has a role to clarify the issue of land ownership to not only small scale farmers but to the entire rural community as it often creates tension during rural development processes. Just as urban communities own the title deeds for their properties, rural communities should also have legal ownership documentation as proof that they own their land.

As the population grows, it puts more demand on food production and without good agriculture there is no way that government can achieve food security. Agriculture is affected by factors such as, the changing climate, shortage of land that has been taken by developments and general shortage of water. Therefore it is important for government to ensure that other natural resources such as water and land are adequately conserved. For instance, it should assist small-scale farmers with conservation programmes especially now that climate change has caused so much damage to the fertile soil. It should subsidise fertilization of land and adequate irrigation systems for farmers in order to afford them a change to sustain their farming.

The role of government is to ensure that people have access to food, as stated in the South African Constitution Act of 1996. During natural disasters such as floods and droughts, government has the responsibility to ensure that people in distress are assisted with food as a temporary relief. It also has to help farmers during agricultural production failures caused by either floods and drought or any other natural disasters. It should ensure that it provides assistance so that the supply and markets continue to operate.

More research has not been conducted on small-scale farmers and their food insecurity. This has resulted in the contrasting statements and findings on the status of food security in South Africa.

In an effort to address food insecurity, in particular in rural areas, the South African government introduced an integrated food security strategy, which was meant to increase household food production, food trade, income opportunities and improve nutritional status of rural communities. Although the strategy was good, it failed to channel government to the root cause of household food insecurity. The implementation agents were also not fully equipped and capacitated; therefore it failed to reach the intended target group.

The Department of Agriculture is the custodian of food security in South Africa but its efforts to promote food security through Zero Hunger Strategy did not bare fruits. A good programme that was aimed at building capacity and ensuring effective support to farmers by exposing them to opportunities failed the same farmers it was intended to assist. Another programme that was rolled out in South Africa was

Comprehensive Agricultural Support Programme (CASP), which in its nature was a financial mechanism to facilitate agricultural development to targeted levels of clients. However the allocation of resources in this programme was reported to be unequal by farmers, therefore failed to make an impact.

Research has also shown that much has been done by government to reduce food insecurity, however, it has also been evident through the results on food security studies that there is a good relationship between poverty and food security, which then meant that they influence each other. Without alleviating poverty it is difficult to achieve food security.

Given this background, there is enough evidence to draw a conclusion that agriculture plays an important role in poverty alleviation by reducing food prices, creating jobs and providing food, however special attention needs to be given to the consideration of financial circumstances of small scale farmers in order to determine the strategies suitable to make a positive impact in their food production. Government and other sectors need not only invest heavily in projects but should also improve capacity and continuous monitoring and mentoring of small scale farmers, to enable them to grow in farming.

5.8 SOUTH AFRICA'S CLIMATE CHANGE POLICY RESPONSE

South Africa has accepted the reality of climate change and has made initiatives to adapt and mitigate the impact of climate change. As a member Party of the UNFCCC and the Kyoto Protocol, it has pledged its commitment in reducing its emission. To enforce its commitment, it has launched its National Climate Change Response Policy intended to manage the impact of climate change through the capacity of its citizens on social, economic and environmental resilience. It also commits to its obligation to reduce greenhouse gases as agreed to by the UNFCCC (DEA 2012).

In its call to both private and public sectors including civil society, South Africa introduced its National Environment Management Act of 107 of 1998 (NEMA), with an intention of protecting its citizens from harmful use of environment and ensuring that development serves the needs of present and future generations. In aligning itself to the Kyoto Protocol, South Africa developed its National Climate Change Response Strategy, which covers the national priorities such as rural and infrastructure development, job creation, poverty alleviation and education (DEAT, 2012).

It is evident that in South Africa like in most other African countries, almost all sectors, government, business, industry, mining and the community at large are affected by the impact of climate change. Therefore, it is only proper that an integrated strategy be drawn to manage the situation. To keep up with international and regional community, South Africa's response strategy gives detailed information about climate change and its impact, how it can be adapted and mitigated. The key issues addressed by this strategy include, the need to have climate change related education, training and capacity building. People need to understand the impact of the changing climate in order for them to make informed decisions on adaptation measures (DEAT, 2012).

Partnership between government and industries in order to come up with mutual ways of reducing emission cannot be overemphasized. Emission by one industry affects all other sectors, so regulatory policies should be enforced. It is equally important for South Africa as a Party to international agreements to meet its international obligations to the United Nation Framework Convention on Climate Change (UNFCCC) meetings. This will keep the state well informed on developments on global climate change and decisions taken in those meetings.

In addition, it is important for South Africa to keep inventories of greenhouse gases and pollutants so that when discussions that need decision making are made, basic adequate information is available to work on appropriate adaptive strategies. Lastly, South Africa needs to have legal provisions in place that would assist in managing and controlling the emission through law enforcement to emitters (DEAT, 2012).

The strategy is in line with the Constitution of the Republic of South Africa No. 108 of 1996. Its Section 24 states that:

Everyone has a right –

- To an environment that is not harmful to their health and well-being; and
- To have the environment protected for the benefit of present and future generations, through reasonable legislative and other measures that;
- Prevent pollution and ecological degradation.
- Promote conservation; and
- Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development (Constitution of the Republic of South Africa, 1996).

White Paper on Integrated Pollution and Waste Management was made to outline government policy on pollution and waste management. Most people in South Africa, in particular those from rural communities, burn their waste and generate unnecessary carbon dioxide. They do it because they do not have waste bins and waste services like people in urban areas, and therefore it has become a way of disposing waste.

Municipalities at local level are tasked by NEMA to manage waste and other harmful material and to control the disposal through the enforcement of the bi-laws. However, the scenario in rural areas differs as there are mostly no basic services even the bi-laws do not apply. However, government still faces the challenge of educating and providing capacity and resources to promote adaptation (DEAT, 2012).

5.9 STATUS OF FOOD SECURITY IN SOUTH AFRICA

FAO (2008) highlights the four dimensions of food security namely, food availability, food utilization, accessibility and food stability. This should be the yard sticks in which food security is measured. More research in South Africa has used different approaches and methods to assess food security in the country. For instance, there has been General Household Survey (GHS), Community Survey (CS), National Food Consumption Survey (NFCS) and South African Social Attitudes Survey (SASAS). These were

conducted with the aim of assessing food security status of South Africa, however, all methods present different results.

This has complicated the implementation of developed policies on food security as they do not give a true reflection of South African status, hence the difficulty in identifying and implementing appropriate strategies for intervention.

Although Hart (2009), forwarded an argument that even though reports state that at the national level South Africa is food secure, the same cannot be said about households at the local level. In support of the argument, Rahim (2011) suggested that more than half of the people living in rural areas are still vulnerable to food insecurity. He further argues that food security is not attributed to food accessibility but rather from lack of clear political commitment to social security provisions due to alienation of rural land, unemployment and low employment levels.

This means that the country produces its main staple foods, exports its surplus food, and imports what it needs to meet its food requirement, yet the picture at the level of households is very different. An increase in national food production does not guarantee food security.

Statistics South Africa (2014) reported that approximately 1.5 million South African children suffer from malnutrition, 14 million people are vulnerable to food insecurity, and 43 per cent of households suffer from poverty. Therefore, it is evident that food security is a looming crisis if diligent adaptation/coping mechanisms are employed to cushion households from the devastating effects of climate change.

The debate by researchers is whether South Africa is food secured or not. It has been difficult to address this question without linking it with other aspects such as economy, population, politics and ecology. These are factors that determine whether it is possible for people to access food they desire or not. When people discuss national food security their understanding is based on the fact that every state is responsible for the production and distribution of adequate food needed by its citizens (McDonald, (2010).

However some base their argument on the fact that every country needs to have the ability to manage the citizens' demand and the supply of food. Ecker and Breisinger (2012), argue that the equal demand and supply of food in the country does not necessarily mean that every household that has access to food is food secure. The reality is such that some households within a country are food insecure because they do not have adequate resources or entitlements to food due to lack of resources.

It is also suggested that food insecurity at national level does not mean there is food insecurity at household level. This is because food insecurity in households is influenced by the livelihoods characterised with lack of financial resources. FAO (2010), states that households are food secure when

there is enough food for everyone at all times. However, Andersen argues that the reason why household food security does not necessarily guarantee food security for all is that food in the household does not necessarily meet the demand of individuals in the household.

To find out the status of food security in South Africa without looking at whether in the first place people have access to food, whether at national or household level, it is necessary to evaluate the consumption level, production and the utilization of food. Different households have differing purchasing power which determines their accessibility level. This also depends on whether the purchasing power is enough to afford the purchaser an opportunity to choose the favourable food according to preference or not. In South Africa, there are people who do not have buying power at all but still have to eat.

Some people who have buying power to purchase food are faced with the challenge of access to sufficient food. For instance, people living in rural areas are limited by availability of markets; they have to spend money to travel to town in order for them to access certain types of food that are not available in their areas. In order to say people have access to food there needs to be physical access. This means that there should be adequate supermarkets in the area where people would purchase food. Equally economic access, which is income in terms of cash or entitlements, social grants etc, to enable people to purchase food.

Until people in South Africa are at a point of entitlements where Sen (1981) says its potential to access food, it is difficult to confirm food security. Through four key elements of entitlement, namely production based entitlement, which is when a person grows and produces his own food using his own resources or using the resources of other people. Secondly trade-based entitlement is where a person has the ability to trade something through consumption and purchase food from others through trade.

Thirdly, people can use the own-labour entitlement where a person uses his own skills, knowledge and experience in order to acquire food; and finally, inheritance and transfer entitlement which means that a person is entitled to social transfers from government or other people. This is a challenge to South Africa as there are still people who do not fall within either of those brackets and are the most vulnerable to food insecurity.

In order to qualify food security, food needs to be available for people to eat. There should be supply of food locally and internationally. Hadley (2012) emphasises that the availability of food through local supply is very crucial as every country has to ensure that there is enough local food production and not depend on international market only.

However, there are different views in so far as food availability is concerned. Commonly, it is believed that food availability exists when there is food to sustain a healthy life. But that does not necessarily guarantee the majority access to food, as there are factors that can make food not to be available to sustain

a healthy life and these include, institutional structures, business and market fluctuations and unfavourable government policies.

Some countries suffer the supply of food not because food is not available but because of political instability, for example, the case of Zimbabwe where the supply of food into the country was stalled by political instability. In some countries where there are riots and no water, the investors in the food industry withdraw their investments and there is no supply of food in the country.

In the Mountainous Lesotho there are areas in the highlands where people only rely on the food they produce themselves, due to the fact that because of bad roads up the mountains no vehicle with heavy load is able to climb up and so supply of food is limited. So this sums up that food availability is when sufficient quantities of food are available.

Another important aspect in food security is food utilisation. This is more concerned about how food is prepared, with sufficient clean water and special nutrition aspects taken into consideration. The available food must take care of the individual's psychological needs. The food must be nutritious. There should be nutrients and properties in the food that one eats in order for them to make him healthy. Food must be safe to consume, they should not be rotten food or food out of expiry date. The food should be enough for everybody and be able to provide the diet that one prefers (FAO, 2012).

Based on the definition of food security, a person should be able to consume food that will provide enough energy and active and healthy life. Food utilization depends on how the food is prepared, whether cooked or boiled they must not lose nutrients. However, food utilization depends on which food is in season, as other foods are dried and eaten when they are out of season, therefore proper care should be taken in the processes of preparing and drying that that is done in a proper, clean, healthy way.

Food stability on the other hand stresses that people should have sufficient food at all times. When the level of economy has gone down the possibility of loss of jobs is guaranteed, and this for some people brings instability in their potential to access food. During natural disasters, the food reserves do run dry and cause, instability in the availability of food (IICA, 2009). So the four dimensions of food security are the ones that will determine the status of food security in South Africa.

Aliber (2009) indicates that even South Africa has registered infrastructural developments in most of rural areas, and has reported a remarkable access to electricity, the increasing costs of electricity is the major cause of food insecurity in many households. Most people in rural areas are limited in which type of food due to lack of storage. In most households in rural areas having a refrigerator is still a luxury afforded only by the working class. This means the household cannot keep perishable food. For instance, if the head of the family has been to town to buy groceries, he makes sure that he prioritises non-perishable

food so that they do not get rotten. Most milk products such as ice cream and yoghurt are regarded urban food and yet they have nutritious value for the kids.

South Africa is regarded as a big brother in the Southern African region, as a result, its food security is very important to the stability of the entire region. South Africa has also been a supplier of food at regional level. The report by Daily Sun (2017) indicates that due to hunger, more African women have turned into prostitution in order to survive. Drought in the neighbouring countries, have let African women to resort to selling sex and other exploitative behaviours in return for food and money. It is also reported that more African women leave their countries such as Zimbabwe, Zambia, Malawi, Mozambique and Lesotho out of desperation to look for work in South Africa but not all of them find proper jobs and some resort to prostitution as their fulltime work or as a way of augmenting their salaries.

Young girls also leave school due to lack of water and food, they drop out in order to prostitute for food and money. This is a threat to the region and South Africa as the behaviour has potential to worsen the scourge of HIV/AIDS and rampant poverty. Although there are regional organisations and humanitarian aid programmes in the region, the status of food security is worsening by the day as the illegal immigrants flood into South Africa. It is also shown by Humanitarian News (2015) that South Africa has been able to meet the food demands of its population in the last 20 years, it also shows that the domestic needs on staple food have always been met by 100 percent. Even the imports on meat and dairy products are only to fill any gaps on the variety of products but South Africa is food secured.

Despite South Africa's efforts to maintain its status of food security, conflicts and effects of the changing climate continue to put pressure on its own food production. In 2008 when South Africa's food inflation rate went high, all essential food (bread, meat, milk) and their products also increased. Even though South Africa remained the maize producer, it could not save itself from the shortage of other foods.

Food security has always been South Africa's priority. That was confirmed by the democratic government in 1994, when the constitution was drafted with the idea of food security in mind. South African Constitution states that every citizen has the right to have access to sufficient food and water. That was also confirmed by the government's efforts to increase funding on child support grants, feeding schemes at schools, pension fund, food and gardens for vulnerable groups.

All these programmes were introduced to assist the vulnerable groups such as children, women, youth and the aged with sustainable access to food. Because these were all new concepts into the system from the apartheid background, they could not bear the desired fruits. For instance, the school would receive money for the feeding scheme and appoints a company or local women to cook food for the needy children. However there were always maladministration of the funds in buying food or paying service

providers and that resulted in children being left stranded in the middle of corruption and maladministration of such programmes.

South African government then established the National Food Security Strategy (NFSS), which was meant to make sure that all South Africans have physical, social, and economic access to sufficient, safe, and nutritious food at all times to meet their dietary and food preferences for active and healthy life. Because poverty is manifested by inadequate and unstable supply of food, lack of buying power and poor nutrition, most people living in South Africa are still living in poverty. It has since been difficult for South Africa to achieve its goals on food security.

Although research has indicated that small scale farmers decrease the level of food insecurity in rural areas, it has also been proven that ensuring food security at household level is not possible as it requires at least one person who has income to be a breadwinner in each household, and in most families in the rural areas that is still farfetched. Most people in rural areas live below the bread line and this means some go to bed hungry at least some of the days.

Malnutrition is riving as well due to insufficient, unstable food supplies at household level. It can then be confirmed that because of the fact that many poor people are unable to provide food to their families out of domestic produce due to the change in seasonal pattern and climate change, households will remain forever dependent on income based power to afford them to purchase food (Jacobs, 2009.)

While it can be said with certainty that South Africa is food secure at National level because it still exports some of its food internationally, the status of South Africa on food security at household level is far from being secured. Due to several studies including food security index by Statistics South Africa, South Africa still has unacceptable state of affairs in rural areas, where people still struggle to access nutritious adequate food. The general household survey (2015) indicates that more people in rural areas of South Africa do not have access to food and therefore food insecure.

The trends and experiences of people on hunger reflect the poverty that reduces their power to access food. It has also been highlighted that South Africa still has not found proper methods and tools to measure the status of food security hence the status of food security in South Africa is not known hence government's difficulty in regulating and monitoring the food security status of its population, although several methods were used to measure food security, methods such as National food consumption survey (FNCS), General household Survey (GHS), Labour Force Survey (LFS), Income and Expenditure Survey (IES), Community Surveys (CS), and South African Social Attitudes Survey (SASAS) (De Cock, 2013).

All methods give different results although common. The commitment that was done by the South African government to half poverty and eradicate food security in 2004 and 2014 failed and left Integrated Food Security Strategy (IFSS), which according to others, already leaves much to be desired.

When it was achieving the desired goals the government transliterated it to the integrated food security and nutrition Programme

5.10 SUMMARY

This chapter outlines the view of South Africa's climate change that it encounters with the changing climate and food insecurity. It touches on the economic factors, environmental and social factors that influence the impact of climate change.

The chapter deals with climate change and its impact. It is projected that the country will remain semi-arid country, that is, hot and dry. Climatic predictions and possible changes in climate impact on water, agriculture, food security and health have also been discussed in this chapter followed by possible adaptation strategies.

This chapter also highlights shortage of water as a threat to other sectors as it influences agriculture, mining and industrialisation, and all this leads to economic growth that sustains food security. Agriculture is the pillar of the economy in rural areas but it needs a concerted effort by all role players to adapt to its effects. With agriculture left vulnerable to climate change and escalating prices of food, it would be difficult for food security to be achievable. When food production is low and the population is growing at an alarming rate, it is difficult for demand and supply of food to be met, and this leads to poor health and introduction of more new diseases.

This chapter reflects on adaptation strategies that South Africans can use in order to cope with the effects of climate change. It would be crucial for the South African government to invest on adaptation strategies to manage the effects of climate change, through (a) crop diversification, (b) drought-resistant species of plants and animals, (c) reduce waste that goes into dams, rivers, and lakes to avoid contaminating water resources, (d) increase and improve job creation, (e) lifestyle diversification, (f) increase health services by improving primary health care facilities.

Livelihood in South Africa is discussed in this chapter to enable an assessment of factors that cause vulnerability of climate change to some sections of the society. Although it is clear that the people in urban areas are less vulnerable than those from rural areas the intensity of the effects differs from area to area. Due to the high rate of unemployment and poverty, government needs to invest in its rural masses in order to accomplish climate change adaptation goals.

This chapter outlines the role played by agriculture in South Africa. There are two groups of farmers in South Africa, namely commercial farmers and small scale farmers. Small scale farmers are dominated by farmers from rural areas who are subsistence oriented while the commercial farmers are profit oriented. The latter often have adaptation strategies at hand whenever climate changes occur which, is one other

reason why agriculture has put South Africa on a map of international market, as exporters of maize, fruits and wines to say the least. The bigger population in rural areas are employed in agriculture which has sustained the rural economy.

Small scale farmers' contribution to food security has been shown to be more fruitful to rural communities and for sustaining rural economy. However, the poverty levels frustrate their efforts to effectively adapt to climate change in reducing poverty and hunger through backyard food production. Even though they do not have mechanization and agrochemicals to pursue their agriculture, they use their indigenous knowledge and traditional skills to sustain food production. It is either done for domestic consumption or income earning in South Africa.

Contribution of small-scale farmers has the capacity to improve food security in rural communities if well organized and prioritized. Government has to restructure its institutions to strengthen its assistance to small scale farmers to give them capacity and resources to produce more food. Land redistribution and allocation needs to be strengthened if government is serious about developing small scale farmers in rural areas. The status of food insecurity in the country is still a threat to the country's economy.

The Constitution of South Africa mandates government to ensure that the right to food is fulfilled. It is the duty of government to ensure that all sources of food are effectively operational, that includes food production, processing, packaging, distributing and making sure the food produced reached South African population. Government needs to ensure that all systems are legally operational and are working within stipulated legislation.

It also has a mandate to set up an enabling environment for markets and trading in and outside of the country, while equally making sure that food that is consumed is an internationally accepted food with safety standards. It is also government's role to ensure that strategies are created to deal with the effects of climate change to protect sustainability of food availability and accessibility in the country.

South Africa has the responsibility to protect its citizens against the effects of climate change. As climate change is an international phenomenon, it is crucial that South Africa joins other countries through relevant structures and participate in international forums that work towards reducing emission of greenhouse gases and the impact of climate change. South Africa has developed response strategies to climate change. It has also adopted legislation, policies and frameworks, even the bi-laws that protect citizens against misuse of natural resources, it is still to mainstream climate change in all its programmes in an effort to incorporate climate change risks in people's livelihoods.

According to the definition of food security, South Africa still has a long way towards achieving food security. When there is still inequality and skewed distribution of resources, one group will always be

food secured at the expense of another group. South Africa is said to be food secured at the national level, but the same can not be echoed about individuals and their households.

CHAPTER SIX

THE STATUS OF FOOD INSECURITY IN LIMPOPO PROVINCE OF SOUTH AFRICA

6.1 INTRODUCTION

Limpopo is one of South Africa's Provinces that is characterized by poverty stricken rural areas. Agriculture is a cornerstone of its economy. It is also characterized by unemployment and low pace of development. Although mining, manufacturing and trade sectors are significant, agriculture is central for its rural economic growth. Public sector also remains an important sector that sustains a large population of labour in the Province.

The purpose of this chapter is to give the over view on the status of food insecurity in Limpopo Province. The impact of climate change and how small scale farmers in this Province cope with this impact are discussed in this chapter. The adaptation strategies and the barriers to effective adaption are also identified and discussed. The role of government in assisting the small scale farmers to adapt is fully discussed.

Many studies have been conducted in trying to get a better picture of the status of food insecurity in Limpopo including the one by the National Household Survey which has found that it has a bigger challenge in accessing food. The different indicators used in the studies included the household composition, household income, household food consumption, household food production and household access to food. The indicators confirmed that for most households where there were male heads of household, the income made a huge difference in food access.

In most of the households where they were involved in agriculture, food access was better than households without farming activities. There was also a relationship between those who had income and those educated and therefore stood a better chance of accessing food through purchasing power. In addition household food production was not favoured by many due to the effects of climate change which reduced crop production to an undependable level. It was therefore agreed by Dec Cock (2012), Altman (2009), Hart (2009) that education, in order to attain better employment, is crucial for people in rural areas. However, at the end of this chapter the status of food security in Limpopo is given a clear picture.

6.2. PROFILE OF LIMPOPO

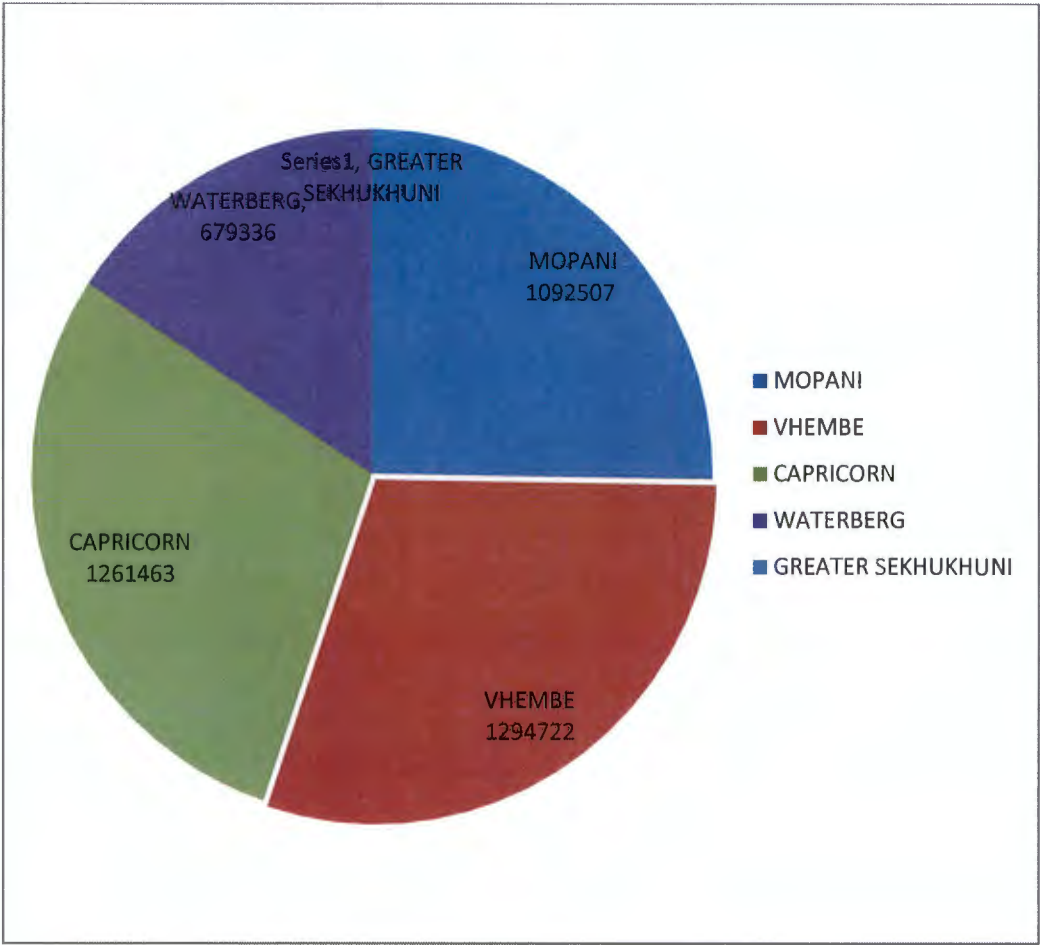
Limpopo is the Northern Province of South Africa. The Province is named after the Limpopo River that runs through the Province. Its capital town is Polokwane, initially known as Pietersburg until 2003. The Province was made from the Northern Transvaal Province in 1994, and with the regime change, the name was changed to Limpopo Province. Limpopo's western parts are semi-arid and the eastern parts are

largely tropical. Although it falls in the summer rainfall region, the northern and western parts experience droughts (Maponya, 2014).

LIMPOPO POPULATION BY DISTRICT

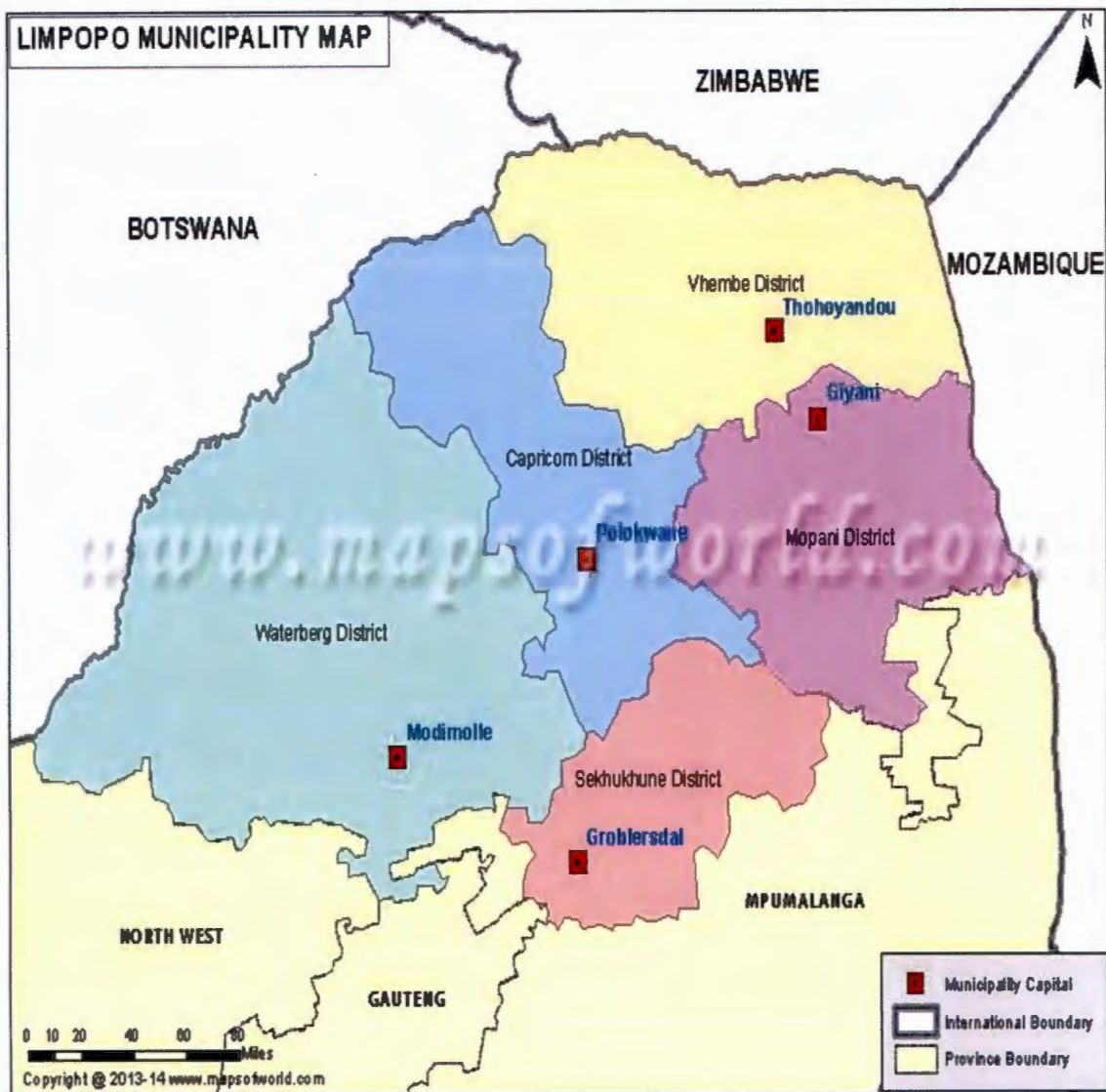


Table. 6.1 Limpopo Population by Districts



Source: StatsSA 2011,

Figure 6.1 Limpopo Municipal Maps.



6.2.1 Geography

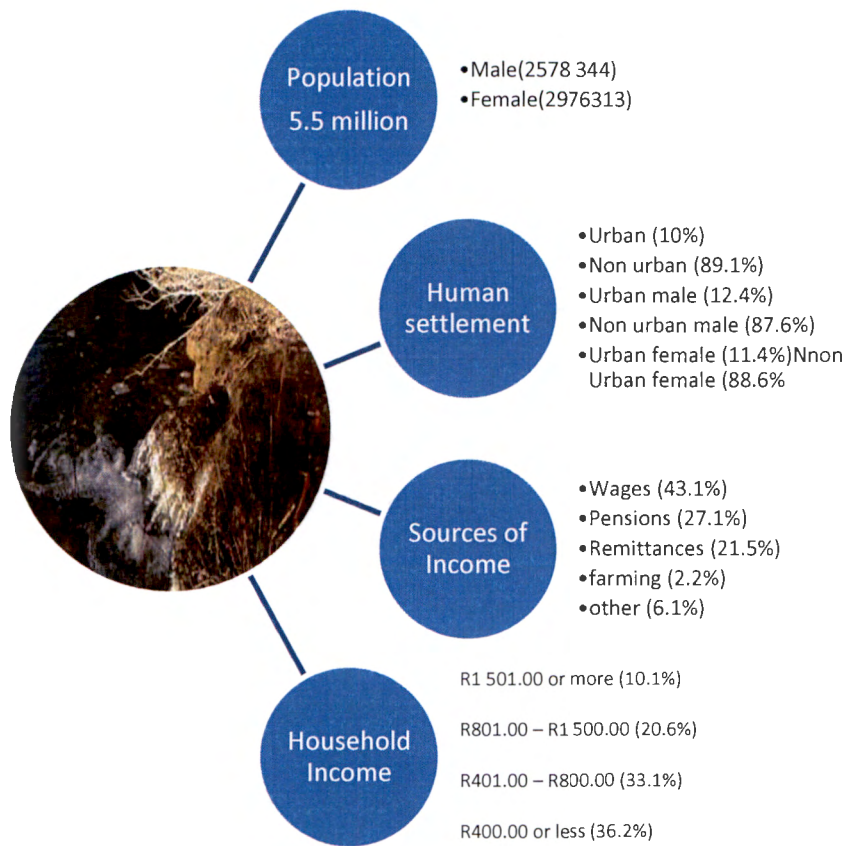
Limpopo shares international borders with Botswana, Zimbabwe, and Mozambique. It also shares its borders with other South African Provinces such as Gauteng, Mpumalanga and North West Provinces. According to Stats SA (2016), the population of Limpopo is about 5 404 868 million over an area of about 123 910 square kilometres. It is divided into four (4) districts namely, Greater Sekhukhune, Mopani, Waterberg, Vhembe and Capricorn. Majority of people residing in Limpopo are black African, who form 96.7 percent, white people only account for 2.6 percent, and Asians and Indians forming only 0.3 percent.

Winter season throughout Limpopo is mild and frost free. Water is generally limited in surface and underground sources. Most areas still do not have satisfying water access. Its bio geographic location also influences its grassland and forest biomes. Climate change has contributed to the changing rainfall patterns. Rainfall is very unreliable and droughts frequently occur.

Effects of climate change felt by the people in Limpopo include in shortage of water due to high temperatures and reduced rainfall. Precipitations which comes with storms and floods have also created disasters in Limpopo. These changes in climate have had implications for agriculture which is the pillar of economic development in the Province. Although Limpopo is one of the biggest vegetable producers, and rich in agriculture, climate change remains a threat to agricultural production (De Kock, 2013).

Fig. 6.2 Economic Characteristics of Limpopo Province, Source. StatsSA (2011)

Source: S.M Pheto (2017)



The economy of a country is a good reflection of the status of poverty in that country; the same applies to the economy of Limpopo compared to other Provinces in South Africa. Its economy is gradually growing and it contributes as a fourth Province to the Gross Domestic Product (GDP) of the country. The only challenge is poverty that is created by the Province’s inability to create employment to enhance rural development.

Figure 6.3 shows that most people earn less than R500.00 per month, which in real life does not even buy a pair of jeans. This translates into the majority of people not working but living on handouts. This simply means that most people are only able to buy food that does not last long. Due to this low level of income most people cannot do any diversity of their livelihood by either opening business or providing

services as lack of education also translates into lack of skills and limited knowledge on finer things of life.

6.2.2 Education

In order for Limpopo to develop as a Province and grow its economy, it is important to invest in its people's education. Although literacy levels of Limpopo are improving as indicated by Limpopo Government (2012) and the number of people who did not go to school has also declined, the government still has to prioritise education and provide proper resources for training and development.

When education is made the responsibility of the public sector, private sector and business, it will be easier for more people to acquire appropriate skills and knowledge. Skilled nation goes a long way with development and economic growth as it is easier for job creation for different sectors when people are educated.

According to Kgetjepe (2016), the budget on education in 2016 was R27.2 billion which was larger than other departments in the Province, showing how committed the Province was to improving the status of education in Limpopo. However, Paterson (2016) indicates that the amount of billions given to the department does not justify the bad performance of the department during the past five years. She reiterates that the department still fails to deliver good education to the people of Limpopo. This is somehow attributed to lack of proper administration which flows down to the school management levels. Some still attribute this situation to frequent political changes in leadership.

Bad governance has caused the Department of Education to remain under administration due to declining performance. The devastating infrastructure of schools makes education a non priority for people staying in rural areas. Limpopo is one of the Provinces with serious school infrastructure problems. There is shortage of about 41 000 toilets in schools, of which 34 000 are pit latrines. The department still reports its intentions to replace them. There is a shortage of class rooms including space to accommodate beginners in grade R. This includes schools that were destroyed during service delivery protests. Some were destroyed by severe storms years ago but the roof is still not yet fixed, windows are still broken with cracked walls and floors (LEDET, 2013).

Limpopo is the only Province in South Africa where the Supreme Court had to make a judgement for the school children to receive their text books at the beginning of the year, due to the failure of government to act on learners' rights to education (Paterson, 2016). The behaviour of the people from Limpopo includes taking their anger on burning schools which is the reflection of low levels of education. This only explains some of the factors that influence poverty in the Province.

6.2.3 Access to Water

Limpopo province, like all other provinces is faced with the challenge of shortage of water. Its economy is reliant on agriculture and mining which are the two major users of water in the province. The demand and supply of water in Limpopo is put under pressure by the increasing population, growing demand for water sanitation, water services, agriculture and mining activities. Increased urbanisation and land transformation can also not be ruled out due to the fact that they also have a hand in the shortage of water in the province (WRC, 2011).

The current water supply is almost fully allocated, requiring that water resources be supplemented by interbasin transfers. The availability of water is reliant on the current climate, population, and nature of economic activities in the province. The rain is not coming as expected and its patterns are unpredictable and unreliable. The majority of the province is semi-arid and receives only 401-600 mm.m², which is relatively low and may cause water stress even in future. There is dire need to improve water infrastructure and water sources in the province given the fact that there is also growth in agricultural irrigation, mining and industrial sectors in water use, which requires increased abstraction of water. The pollution of water from these sectors including the domestic use is also a challenge to managing water effectively in the province.

LEDET (2013), cited the following concerns about water resources in the province; (a) conflict and competition arising from water scarcity, (b) ageing water infrastructure and limited access, (c) expensive inter-basin water transfers, (d) skewed distribution of water resources by major sectors, (e) insufficient water resources available for new developments, (f) lack of access to clean water and, (g) contamination of water resources arising from malfunctioning waste water plants.

In Limpopo, water is stored in rivers, dams and groundwater but all are affected by over abstraction. According to DWA (2015), the volume of water storage in Limpopo has decreased due to the impact of droughts and extended dry season. Another worrying issue for the province is surface water pollution as excessive waste from the mining areas is contaminating drinking water for both animals and humans leading to deterioration of water supply. Due to shortage of piped water in rural areas, those who can afford, use boreholes and this creates problem of contamination of the water they use.

Due to shortage of proper sanitation in rural villages, the use of pit latrine has created an increase in faecal pollution especially in the river systems. According to WRC (2011), all water management areas in Limpopo province experience poor or unacceptable faecal pollution. This is also confirmed by DWS (2014), which indicates that nationally, the risks from the consumption of contaminated drinking water are higher in Limpopo province than others due to the fact that many people use water from untreated

water sources. It falls upon Limpopo government to make this pollution a priority as it affects the availability of water, particularly in rural areas.

According to CSIR (2010), the following constitute the impact of water resources in Limpopo; (a) increased risks to the quality of water in rivers and their ecological state, (b) decreased availability of water in rivers as a result of increased temperatures and evaporation, (c) temporal changes in high and low flows due to change in rainfall patterns, (d) greater rainfall intensity is also expected to increase sedimentation in dams, and (e) greater floods incidents as heavy rainfall events increase.

This has been a clear sign that there will be shortage of water and therefore strict measures should be planned. Limpopo province therefore has to invest in strategies of water conservation, re-use strategies as well as utilization of groundwater resources (DWA,2015).

According to StatsSA (2011), Limpopo government has improved access to water inside their yards. More piped water inside dwelling HOUSES is growing in rural areas of Limpopo. This has made lives of most people better and some who engage in small scale farming have benefited from this development. The improved access to water has also increased the number of households that use flush toilets instead of pit latrines. This has effectively improved sanitation facilities in most of Limpopo’s rural areas.

6.2.4 Access to Housing

Proper housing in any area is an indication of development taking place. Most of South Africa’s rural development priority is decent housing for its people. Limpopo Province is one of the Provinces with housing backlog for its people. Most of Limpopo’s households live in formal dwellings (1.4 million or 88.9%) and informal dwellings of about 77 371 or 4.8% in the country. About 5.1 %or 81 747 are living in traditional dwellings. This has caused many service delivery protests by rural communities in demand of housing. The table 6.2 below shows how dwellings are spread across Limpopo Province.

HOUSEHOLDS LIVING IN LIMPOPO: TENURE STATUS BY TYPE OF MAIN DWELLING							
	Census 2001			Census 2011			
	Owned	Rented	Occupied rent-free	Owned	Rented	Occupied rent-free	Other
Formal dwelling	62%	7%	32%	58%	12%	27%	2%
Traditional dwelling	57%	1%	41%	58%	5%	36%	2%
Shack in backyard	48%	15%	37%	45%	27%	24%	4%
Shack not in backyard	38%	7%	55%	47%	19%	31%	4%
Other	42%	11%	47%	36%	28%	29%	7%
Total	59%	6%	35%	58%	13%	27%	2%

Source: Census 2001, Census 2011

As stipulated in the South African Constitution of 1996, it is the right of everyone to have access to adequate housing and the state is given the mandate to ensure that through its programmes the this right is

achieved. In response to this mandate, Limpopo province also has as its programme, the Integrated Residential Development Programme through the Department of Human Settlement; the programme provides the poor households access to adequate housing. The programme has assisted most people including those from rural areas to be well located in areas that provide access to urban amenities, including their work places (LEDET, 2015).

According to Barnard (2010), most people settled informally the land that was not demarcated for residence and government had to assist them and integrate them well into society, a sign of shortage of housing for people in Limpopo. Through Informal settlement upgrading programmes, the government of Limpopo assisted the informal settlements by upgrading their living conditions and providing them with secure tenure and access to basic services.

The intention is to improve their social and economic circumstances and for majority of people the programme worked. However, Madzie (2013) argues that the provision of houses is one of the reasons why there are conflicts in the province, due to the corruption that goes with the building and allocation of houses by the municipality officials. Magoro (2010) also cites conflicts amongst the communities regarding housing fuelled by poor administration, limited capacity of contractors appointed to do the job, lack of transparency in the process of allocation of houses, absence of inspections and regular monitoring of contractors as well as political interference.

Despite all the housing challenges experienced by the people of Limpopo on housing, Noble (2010) says that it is still worrying that the nature of houses in most areas is vulnerable to the effects of climate change. The structure is not strong to withstand strong winds and storms. The yards are so small that they do not leave space for food garden even if the owner wanted to do backyard farming. Most of the houses do not have gutters as a result do not allow them to harvest water during rainy seasons. It is therefore a challenge to the relevant authority to ensure that they integrate climate change in their programmes to enable them to cover these pertinent issues (Mostert, 2010).

Limpopo's common form of sanitation, according to information below, is pit toilets without ventilation followed by flush toilets with sewage. However, it is encouraging to see that bucket toilets are almost not available in Limpopo even when they still exist somewhere else in South Africa. It is still worrying that at this age, there are people who still use open space, hide behind trees and bushes to relieve themselves because they do not have ablution facilities. This has been declared as an insult to the human race and violation of human dignity.

When those who are responsible fail to address concerns of the communities, such as provision of service delivery to communities, it calls for the exacerbation of other problems such as air-borne and water-borne diseases caused by lack of hygiene. Due to the remoteness of rural areas it is easy for diseases to spread

especially when not prevented or controlled in time. With poor primary health care in villages far away from hospitals, lack of good sanitation is really a threat to the health of rural communities (Mandlene, 2011).

Table 6.3 Status of Sanitation in Limpopo and South Africa

	SA	LIMPOPO
Flush toilet connected to sewage	8 242 924	279 619
Flush toilets with septic tank	442 481	30297
Chemical toilets	360 703	12 197
Pit toilet with ventilation	1 266 102	214 325
Pit toilet without ventilation	2 786 068	749 740
Bucket toilets	297 847	8 759
Other	305 444	21 131
None	748 592	102 035

Source: Quantec Research (2012)

6.2.5 Access to Electricity

Electricity has economic, health and environmental impact because many activities depend on electricity to be done properly. According to DE (2015), Eskom electrified over 991 602 houses. About 9 381 houses were supplied with non-grid technology (solar panel – renewable energy). Limpopo provincial 15 year Review report indicates that 81.2% of the people of Limpopo have access to electricity. Even though gas and paraffin are still used in some households, more electricity has been provided. Very few still use coal, solar wood and cow dung to cook. More electricity is needed by the people of Limpopo because it has an effect on their production, education, health, telecommunication services and many other services.

However Madzhie (2013), argued that even though progress is made in electrifying most of Limpopo’s rural areas, the consumption levels of rural customers are so low that it is impossible for Eskom to recover capital and operations costs from the tariffs alone. Noah (2012) also indicates that most households from rural areas are low income group therefore, for them, payment of connection charges is obviously difficult hence some can not even afford to connect even if the village has electricity. The other challenge of rural communities alluded to by Barnard (2011) is that most unemployed households find

electricity very expensive and even when they are connected they cannot afford to buy electricity coupons.

According to White (2013) due to agriculture, mining and industrial sectors in Limpopo, the greenhouse emission intensity of the electric sector becomes higher, particularly due to the use of fossil fuels by rural communities especially coal and chemical fertilizers. Therefore the use of other forms of off-grid technologies such as solar panels will contribute to the reduction of carbon dioxide emissions in Limpopo. Again government of Limpopo should convince the treasury to subsidise electrification for lower income earners and the unemployed so that all citizens have access to electricity.

6.2.6 Tourism

The Province accounts for over 5% of all foreign tourists in South Africa. Tourism is one of the three pillars of the economy in Limpopo and it is growing annually. The Province is channelling its efforts in making itself a preferred ecotourism destination. Peter Mokaba stadium is very effective in bringing people to Limpopo and is a good economic boast for the Province. Even though the Province is not rich, it prides itself in the wildlife which adds to its attraction to the outside world. At Sunland Baobab farms in Limpopo, there is a large Baobab Tree that has fashioned itself into a spacious pub and presents a good tourist attraction.

According to HSRC (2013), Limpopo tourism contributes significantly to the national and provincial economy. There has been a steady increase in the growth of domestic tourism while international tourism declines as a result of the global economic meltdown.

For example, in 2014, several holiday resorts in Bela-Bela, Limpopo, were flooded and the dam overflowed to the resort, about six lodges were severely affected by the strong winds and the floods and over seventy people were airlifted to a hill in Lephalale after they were left stranded and 145 others had to be rescued by emergency personnel. This was a clear indication of lack of preparedness of the province for natural disasters as there was not even a flood warning by the South African Weather Services. Bela-bela depends on tourism and game lodging for survival (News24, 2014) and it is therefore important for Limpopo government to ensure that they improve their disaster management department to protect the tourism sector as it also contributes to the provincial economy.

6.2.7 Economy

Limpopo is fairly a developing Province and also one of the poorest regions with a notice able gap between the poor and the rich; majority of the people live in rural areas. It however exports its primary products and imports mostly manufactured goods. It has increased big businesses in an effort to create jobs and development, and it is also a home of big mall called the Mall of the North.

Figure 6.3 Baobab Tree Turned into a Pub.



Source: www.bigbaobao.co.za

However, there are factors that have been highlighted by previous studies that are barriers to Limpopo's growing economy. Maponya (2012), highlights the following factors as delaying development in Limpopo. Poverty is one challenge that affects all; Political instability of the leadership of the province affects service delivery; Lack of government and its will to facilitate trade and local markets for the agricultural production; Lack of capacity of the provincial government to deal with concerns of communities amicably; Dissatisfied communities of Limpopo have regressed their own rural development by destroying public facilities such as schools and government offices when they demonstrate.

Limpopo's economy is represented by agriculture, mining, manufacturing, and construction. According to LDT (2016), mining at Limpopo dominates 25% of the provincial economy. Platinum dominates mining employment followed by coal and iron ore, while gold had job losses due to gold loss in the market.

Mining contributes more than 5% of Limpopo's provincial economy. The Province is blessed with rich minerals such as iron ore, platinum, chromium high and middle grade coking coal, antimony, copper, phosphate, and diamonds. It also has mineral reserves such as emeralds, gold, vermiculite, mica, granite and magnetite. Limpopo is known as having the largest platinum deposit in South Africa. There are also commodities such as Coalfield, which is the eastern extension of Botswana's Mmamabula coalfields, and contains 40% of South Africa's coal resources.

Table 6.4 Relevant Biographic characteristics information of the Limpopo Province source: SM Pheto (2016).

INFORMATION	FIGURES
Size	125 755 km square
Population	5.4 million
Rural nature	90%
Unemployment levels	38.9
Poverty levels	12.6
Those receiving salaries	37.8%
Those receiving grants	33.8
Female headed families	49.2%
Hunger in households	4.4
Small holder livestock	68.3
Crop production	32.2
Fruit production	44.8
Access to food	53%

The bulk of jobs come from agriculture and construction despite their relatively small shares in the provincial economy. The top manufacturing industry in Limpopo for employment is the food and beverages and clothing.

Unemployment is relatively high in Limpopo and there is a small portion of employed population located in the former homelands regions. According to Stats SA (2015), Limpopo has relatively low income levels which do not sustain local economy. There is no metro area out of its 30 municipalities and one secondary city Polokwane, which has 9% of the province population. The total budget of Limpopo is R45 billion of which 89% goes to education and health. Economic development, tourism and agriculture, together account for R2.8 million.

As a developing area, Limpopo exports primary products and imports manufactured goods and services. It has a high potential for development of resources such as agriculture, tourism, minerals and abundant labour that is strength for investment opportunities. In its bushveld extensive ranching operations and controlled hunting makes Limpopo 80% of South Africa's hunting industry.

According to DAFF (2016). Limpopo supplies South Africa with peanuts, maize, cotton and table grape crops. Tropical fruits such as bananas, mangoes, pawpaws, pineapples and litchi are grown in Limpopo and for years have sustained local economies. Limpopo is known as the “garden of South Africa” because the majority of South Africa’s fruits come from Limpopo.

Polokwane international airport is very effective in transporting people in and out of the Province via OR Tambo international airport. The Province has good roads, railways including the airline. The N1 route from Limpopo to Gauteng is the busiest overland route in Africa as it provides for the cross-border trade in raw materials and goods (Noble, 2010).

According to Limpopo Economic Development Plan (LEDP) (2016), the following strategies are intended to grow the economy for sustainable development in Limpopo, (a) increase employment, (b) establish a competitive base of infrastructure, human resources and regulatory framework. (c) increase the quality of education, training and innovation, (d) create an economy that will make employment, (e) improve infrastructure to enable inclusive and integrated economy.

Through its Limpopo Development Plan (LDP), Limpopo intends to invest in the upgrade of informal settlements, public transport infrastructure and systems, procure about 20 000 mv of renewable electricity by 2030. To make sure that all these happen, Limpopo, through its Limpopo Employment Growth and Development Plan (LEGDP), intends to bring together provincial government, municipalities, and private sector and other organs of civil society to participate in Limpopo economic growth (LEGDP, 2015).

6.3 DEMOGRAPHICS OF RESPONDENTS IN LIMPOPO

Table 6.5 The Demographics of respondents in Limpopo

	MALE	FEMALE	TOTAL
Limpopo	7	13	20
Total	14	31	45

Source: SM. Pheto (07/2017)

Limpopo has a unique feature of females being more than males in the Province according to NDA (2011); the Province accounts for 52.2% of women nationally and Statistics South Africa (2011) also indicates that Limpopo has the highest ratio of females and they account for 54.7per cent.

(a) Gender

As the study classified its participants according to gender, small-scale farmers were purposively selected with the female outnumbering male farmers. This came from the research and surveys conducted which show that in rural areas, more small-scale farmers are likely to be women. (Stats SA, 2015). This is

supported by Altman et al. (2009), who state that globally, women make over 60 percent of farmers, even though they are often excluded when success stories in agriculture are told. These have been consistent in most parts of the world.

This was also confirmed by FAO (2015), that due to men migrating to urban areas for employment, women are left at home to take care of families and in most cases agriculture is the only source of food. Some women find themselves heading their families when their male partners die. Women were spread across the five districts of Limpopo. Women were found to be more willing and available participants in the study. Out of twenty (20) participants from Limpopo, thirteen (13) were female farmers

(b)Age

Table 6.6 Ages of Respondents

AGE	TOTAL	PERCENTAGE
25 – 35	4	20%
35 – 45	4	20%
45 – 55	8	40%
55 – 65	4	20%
TOTAL	20	100%

Source: S.M. Pheto (07/2017).

Age determines commitment and perseverance in agricultural practices. When a person is older, the possibility is that they have a wealth of experience in farming and other indigenous farming practices. For older people agriculture is considered a way of life.

However, younger people who engage in farming are those who are really passionate about farming and are committed to make money out of it. The age range of small-scale farmers interviewed was between 30 to 60 years old.

Although farming can be done by anybody, there is a minimum level of education required to assist farmers to engage productively in farming. In recent times education is important in farming as most farming manuals, magazines and reports are mostly written in English or Afrikaans. Therefore farmers need to know how to read and write in order to be able to keep the records for farming management practices and be able to adapt to new technology in farming.

(c) Level of Education

Table 6.7 Levels of Education in Limpopo

	LIMPOPO	PERCENTAGE
MATRIC	10	50%
DIPLOMA	6	30%
DEGREE	4	20%
TOTAL	20	100%

Source: S.M Pheto (07/2017).

It is important for farmers to have basic education that would enable them, for example, to apply accurate measurements when applying fertilizers, livestock medication or any other measurements. All respondents had education up to Matric. Very few had tertiary education (diploma and bachelor’s degrees).

(d).Type of Farming

Table 6.8 Type of Farming in Limpopo

TYPE OF FARMING	TOTAL	PERCENTAGE
Backyard garden	8	40%
Communal garden	1	5%
Private farm	4	20%
School garden	1	5%
Family farm	6	30%
TOTAL	20	100%

Source: S.M Pheto (07/2017).

The definition of small-scale farmers, according to DAFF (2014), is that persons or households that produce food to generate income either as a main source or additional source of food and income. It is necessary to get an idea of whether small-scale farmer does farming in the backyard garden, communal garden, private farm or school garden. This determines the size of farming for accurate and effective adaptations

Fig. 6.4 Some Small scale farmers do their farming on the communal gardens in Limpopo



S.Pheto,

backyard garden in Lephalale, (07/2017)

Most respondents do their farming in the backyard and communal gardens due to shortage of resources and land. Most of the respondents from the rural areas indicated that they use the backyard gardens to produce their crops. Some use their private plots to produce crops and with a piece of land for livestock. They produce for subsistence and sell the surplus to accumulate income.

They use household members as labour as they cannot afford outside labour. It was clear from the responses that although small-scale farmers enjoy farming and are committed to it, with the frustrating climate change, they no longer consider it as a livelihood, but if they find employment that could increase their income they would not hesitate to diversify their livelihoods.

(e). Sources of Income

Table 6.9 Sources of Income

SOURCES OF INCOME	LIMPOPO	PERCENTAGE
Farming	15	75%
Salary	2	10%
Pension	3	15%
TOTAL	20	100%

Source: S.M Pheto (07/2017).

This determines the major source of income that the respondents have. They indicated that they rely on farming for income, however they confirmed that they do better when they have other sources of income,

it assists with money to augment the income from farming especially during the worst farming seasons. Extra income is needed when farming is hit by either floods or droughts; at least the family survives food insecurity. Majority of farmers had farming as their source of income. They relied on crop farming and livestock farming.

This supports what Delgado et al. (2010) suggested that households should have some other extra source of income even if they take farming as a livelihood. It has been already discovered that households that do not have any person employed out of farming are more likely to be unable to access food, but where there is an extra income or wage they are likely to struggle to access food, even worse than those who rely on social grants. This is where the relationship between having an income and accessing food come together in food security.

(f) Availability of Water in Limpopo

Table 6.10 Water Availability

LIMPOPO								
SOURCES OF WATER	QUALITY				QUANTITY			
	Good	%	Bad	%	Abundance	%	Shortage	%
Tap water	4	20%	2	10%	2	10%	4	20%
Piped borehole	2	10%	2	10%	-		4	20%
Communal tap	-	-	4	20%	-		3	30%
River	-	-	2	10%	-		2	10%
Other sources	2	10%	2	10%	2	10%		
TOTAL	8	40%	12	60%	0	20%	25	80%

Source: S.M Pheto (07/2017).

This Province was not spared from the challenges of access to water services. Even though Water Services Authorities and Water Services Providers (WSP) are entrusted to provide communities with water to ensure that everyone have access to water, rural communities in most Municipalities are still without proper water supply (Mothetha,2013).

Majority of respondents indicated that their sources of water and infrastructure are there but they are not properly maintained, therefore they are not reliable and most do not work. About 80% of the respondents in table 6.8 indicated that there is shortage of water in their communities, 60% further indicated that the water is also of a poor quality. Most of the respondents cited lack of capacity at Municipalities as one of the challenges the Province is faced with in so far as provision of water resources is concerned. They

reported that most infrastructures installed during the homeland era are not properly maintained. This, they said, is also strained by the already reduced supply of water and decreased rainfall.

During the focus group interview it was discussed that the rivers and dams are unreliable sources of water lately as the climate has changed. They indicated that even though there were boreholes, they do not meet the requirements of the communities due to reduced rainfall. It appeared that some people are forced to buy water from their neighbours when their communal taps do not have water. Illegal connections of water in congested areas were also highlighted as one of the causes that affect the flow of water to desired destinations.

Table 6.11 Food Availability, Access, and Utilization

LIMPOPO		
IN THE PAST TWELVE (12) MONTHS	TOTALS	%
Ran out of money to buy food	17	85%
Gone hungry when there was no food	2	10%
Had to reduce food portions because food was not enough.	20	100%
Not had balanced diet in your meal	20	100%
Had to skip meals because there was not enough	20	100%

Source: S.M Pheto (07/2017).

Agriculture is a pillar of economic development and an important sector for food security. Even though the provincial government is making efforts to curb food insecurity, the majority of people in rural communities are still vulnerable. About 85% of respondents indicated that they do run out of money to buy food. This situation for them means that they should have an extra income source other than farming. Due to low yield they fail to make enough money to augment their farming produce. Only 10% indicated that they went hungry when there was no food to eat.

All respondents indicated however that instead of starving, they had to reduce their portion of food to leave some for the next meal. Others indicated that due to climate change, they are unable to have surplus

to sell at the market, as a result they can not afford to have balanced diet as they consume what they can afford.

6.4 IMPACT OF CLIMATE CHANGE ON FOOD SECURITY

Limpopo is found to be one of South Africa's poor Provinces, where most households are unable to afford adequate supply of food through agricultural production or people should be able to buy food. The rural nature of Limpopo puts strain on development and influences many other factors such as poverty, unemployment, low income and inadequate service delivery. The major threat to all these factors is the changing climate. Without acknowledging the presence of climate change and its implication, Limpopo small-scale farmers will not be food secured.

6.4.1 Small-scale farmers' perception on climate change

Most respondents indicated that they were aware that there is a change in climate and they have observed the difference in the weather patterns for some time. Some indicated that they were aware but did not understand what was happening. Most of them read about climate change from newspapers and others heard of it over the radio. They have observed unlikely changes ranging from the increasing extreme weather events such as floods and droughts; there have either being less rain or no rain at all which has caused more harm to crops, including abandonment of food gardens.

They indicated that unreliable rainfall patterns and high temperatures have changed their planting and harvesting times. All the respondents were aware of climate change. What they did not know was that they had to take it very serious and start to adapt as it was here to stay. It is therefore necessary that government and private sector form a partnership to ensure that there are better ways of educating rural communities about climate change and how it affects them. They should also be educated on how to read early warning signs in order to plan for disasters and prepare adequately for them. As mentioned earlier they also have their own traditional ways of adapting, it is important for government to integrate the traditional and indigenous knowledge into the modern ways of reading the early warning signs.

Limpopo small-scale farmers reside in rural areas and due to the high levels of poverty coupled with slow service delivery, they find it difficult to survive food insecurity. Most respondents indicated that they already feel the impacts of climate change in their livelihood. About 80% of respondents indicated that shortage of water resources has been a huge disadvantage in their villages.

They have lately been forced to share drinking water with animals because of shortage of water in the Province. Only 20% of respondents indicated that because they have employment outside farming they are able to afford more than one borehole and maintain them, and they have never run out of water.

6.4.2 Climate Change Impact on Small-scale Farmers' Livelihood in Limpopo

Table 6.12. Climate change impact on small-scale farmers' livelihood

VARIABLES	FARMERS	PERCENTAGE
Shortage water		
Yes	16	80%
No	4	20%
Low income		
Yes	19	95%
No	1	5%
Unemployment		
Yes	18	90%
No	2	10%
Poverty		
Yes	20	100%
No	0	0%
Shortage of land		
Yes	17	85%
No	3	15%

Source: S.M Pheto (07/2017).

Shortage of water

The focus group discussed and agreed that shortage of water is a general problem as most of the water sources in rural areas are running dry. In some villages people are forced to buy water for domestic use but cannot afford to buy for animals. They encouraged each other to reduce the number of livestock and keep a reasonable number that could survive the drought.

Low income

Due to high rate of unemployment in the Province, most people depend on agriculture as a source of income and food. However not many people were lucky to be employed and still do their farming as a hobby. About 95% of respondents indicated low levels of income on the farming that the small-scale farmers depend on which are never enough. They can hardly afford to buy farming implements or mechanisation to improve their production. However, for 5% that are employed elsewhere and augment farming income, they afford to adapt to the impacts of climate change even if it is on a small scale, but

they can afford to sustain their farming activities. According to Ndleve (2012), in the midst of climate change small-scale farmers need to diversify their lives to make extra income for food and other needs.

Unemployment

In the group discussion, it appeared that due to climate change and its impact on their food production, other agricultural labourers such as shepherds, and fruit and vegetable vendors had to be retrenched when farmers reduced their farming stock due to shortage of water. Some labourers were forced to leave their families and look for jobs in urban areas and that destabilised the families as not everybody got jobs, others no longer came back home.

When people are unable to produce food and cannot afford to buy food the implication is that they will sink in food insecurity. As indicated by Stats SA (2011), respondents also confirmed that unemployment is also reduced due to climate change. They emphasised that lack of employment reduces their chances of accessing funds for farming capital, which means they find it difficult to grow their businesses.

Poverty

Even though farmers depend mainly on crop and livestock farming, they need other sources of income to curb food insecurity during unfavourable extreme weather events (Neves and Du Toit, 2013). All respondents mentioned that when production fails due to precipitation and high temperatures, people are forced to look for off-farm jobs or face poverty.

In rural areas there is no employment and when farming fail; they fall in to poverty. Most people living in poverty do not have entitlement and rely on handout from other people. Occurrence of bad weather has destroyed family dwellings during floods and storms, and this often drives them into poverty, as rural homes are often not insurable.

Shortage of land

Land is one most important mean of production. A farmer cannot have farming production without land, particularly in rural areas. With insufficient land allocated to farmers in rural areas, Table 6.10 shows that 85% of respondents had no land. They use communal farms backyard gardens, even those who own land, are less than 10 hectares. This confirms the report by Aliber et al. (2010) that those with more land are able to adapt to climate change easily.

The focus group also discussed and agreed that the size of land in agriculture influences food security in households. When one has a large size of land, one is able to produce more. The implication for the small farmers is that they produce small quantities of crops grown in the backyard and are not able to try variety of farming to adapt.

Another issue that worries men and women in rural areas is the issue of land ownership in rural areas. When they need land for farming from their traditional authority, they are told that they can use the available land allocated to them, but they do not have any legal documentation that the land belongs to them and this creates a challenge, especially when they have to apply for finance to develop the land. They are not allowed to buy land and in traditional land, there are always challenges of regulation and conditions by tribal authorities.

6.4.3 Climate Change Impact on Small-scale Farmers’ Agriculture

Table 6.13 Climate change impact on small-scale farmers’ agriculture

VARIABLE	FARMERS	PERCENTAGE
Reduction in livestock production		
Yes	16	80%
No	4	20%
Reduction in crop yield		
Yes	17	85%
No	3	15%
Rising costs of farming commodities		
Yes	20	100%
No	0	0%
Increase in diseases		
Yes	20	100%
No	0	0%

Source: S.M Pheto (07/2017).

Reduction in livestock

As shown in Table 6.10, 80% of respondents indicated that due to drought and shortage of water they are faced with reduced livestock. They explained that due to the changing climate their production of meat and milk were negatively affected. They stated that due to this reduction they are forced to buy meat and milk from the shops, which is more expensive.

It also appeared in the discussion of the focus group that due to droughts and shortage of water, livestock farmers are working at a loss, as most of their animals find it hard to survive, especially in the dry season. This then means that their meat and milk production is reduced, where it is still holding on, there is the issue of quality and quantity that make it difficult for farmers to penetrate the market.

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Reduction in crop yield

Majority of crop farmers indicated that climate change impacts on their farming, which is their main source of food security. Agriculture in rural areas depends on availability of rain but with shortage of rain and change in rainfall patterns, the production of crops is threatened. About 85% of respondents indicated that due to shortage of rainfall, water supply is limited, and reduced water intake can depress crop production quicker than any other deficiency.

The focus group discussed and agreed that even the soil is no longer rich and has reduced its fertility due to the continuous drought and high temperatures. They mostly responded that during the dry, hot seasons, lack of rainfall kills their crops because they depend on rain-fed farming. Others stated that without rain they fail to plant because they would not have waited for the planting time until it is too late to plant.

The group discussion also agreed that the past ten years had been tough for small-scale farmers. Some even left farming because they planted at a loss due to the changing climate. Some indicated that for the past consecutive years they had been discouraged by drought and lack of rainfall to plant. They all indicated that farming is done on trial and error basis as the climate changes anytime.

Increase in farming commodities prices

All respondents interviewed raised the fact that due to climate change, the agricultural commodities, such as feed, fertilizers, pesticides etc., have all increased in price, which makes it difficult for small-scale farmers to proceed with agriculture when there is reduction in their production. Some indicated that due to unfavourable weather patterns they have lost their agricultural income.

Respondents indicated that due to high temperatures the level of diseases to animals has gone up and it is very difficult to treat them especially under shortage of water. Due to heat stress animals have dropped their reproductive rate, they no longer reproduce as they used to, and this becomes a loss to the farmer, as more is spent on feeding the available number while it is not increasing. All respondents confirmed that farming has become a very expensive activity in the presence of climate change.

Increasing incidents of diseases

Without increased food production and availability of employment in rural areas, healthy living is just a dream. With poor rainfall, less fertile soil, less farming activities are guaranteed (Mabaya et al., 2011). When people do not eat healthy food, they are vulnerable to diseases such as malnutrition, HIV/AIDS, cholesterol and diabetic attacks.

Table 6.11, shows that all of respondents confirmed that with climate change at play, more people are getting sick due to rising temperatures and heat waves. They even alluded to the pollution of air that

causes diseases such as asthma, TB, bronchitis and sinusitis. Given the unique character of rural areas, where service delivery is slow, even the health services are so scarce and less resourced.

In the focus group discussion the agreement was that not only does climate change increase the incidents of diseases for human, even animals die of random diseases and due to poverty, people are not willing to burn the animals that died of diseases, they eat them. This increases the transfer of diseases from animals to people, and some funny diseases due to eating meat from sick animals attack some people.

6.4.4 Climate Change Impact on Small-scale Farmers’ Food Security

Table 6.14 Impact of climate change on small-scale farmers’ food security

VARIABLES	FARMERS	PERCENTAGE
Shortage of food		
Yes	19	95%
No	1	5%
Increase in food prices		
Yes	20	100%
No	0	
Low income		
Yes	18	90%
No	2	10%
Unemployment		
Yes	18	90%
No	2	10%
Lack of local markets		
Yes	19	95%
No	1	5%

Source: S.M Pato (07/2017).

Shortage of food

Although food insecurity still affects people residing in the urban areas of Limpopo, those residing in rural areas are more vulnerable as they are mostly poverty-stricken and cannot afford to buy food on daily basis. Table 6.11 shows that 95% of respondents mentioned that their food production is affected by the changing climate. The unreliable rainfall patterns are responsible for the low food production resulting in shortage of food. As there is a decrease in food production, the demand becomes high and this directly affects small-scale farmers through, food price increase, reduction of income, and no market for their products.

The focus group agreed that weather patterns and extreme weather events affect availability of some food, in rural areas there are wild crops that depend on rainfall only and when the crop yield is not good,

villagers go in search for food in the fields, but due to lack of rainfall and droughts the crops are no longer available. High temperatures, drought and floods cause instability of food supply.

When they do not have access to food due to bad weather, the group indicated that they are exposed to malnutrition and other diseases such as cholera and HIV/AIDS. These confirm what was mentioned by FAO (2013), the impacts of climate change will affect all dimensions of food security namely, Food availability, food accessibility and food utilization.

Increase in food prices

All respondents complained about the hiking food prices due to demand and indicated that they are forced to buy food because they cannot produce enough. Respondents mentioned that they have reduced their crop production due to shortage of water in their areas. They highlighted that when they plant more they are able to sell and donate to the neighbours on a good harvest but lately they are not producing enough. It is confirmed that the unreliably changing climate hinders the growth of small scale farmers in rural areas and blocks their effort of emerging into commercial farming.

Low income

One character of small-scale farming is that farmers grow their crops in small portions of plots or gardens; this on its own denies them the opportunity to produce more. Those who keep animals keep only a minimum due to space in their yards; they cannot participate in big beef markets with less than ten livestock; it is already a disadvantage to them (Pinnar, 2013).

About 90% of respondents indicated that their farming income is very low, and cannot even allow them to increase their production, let alone to pay wages of people who assist them. Due to the fact that they do not even have storage space when they have produced more, they are forced to sell everything at low prices before they lose freshness; this also affects their income growth.

Unemployment

Limpopo Province is one of the underprivileged, poorest and victim of unemployment in the country (StatsSA, 2014). About 90% of respondents indicated that unemployment in their rural communities is predicted by illiteracy, as majority of people do not have secondary education. They further mentioned that lack of employment in rural areas has crippled the economy in those areas. Even the 10% respondents who said jobs can be created in farming thinking government is making some efforts, acknowledge that the high levels of poverty and corruption in government may take too long to provide rural areas with jobs.

The focus group discussed and agreed that employment in rural areas, determines the distribution of income and poverty across the Province. They even mentioned that a quarter of economically active people in rural areas are unemployed and this has caused a devastating effect on the welfare, crime, economy, social exclusion and social instability. In the definition of food security, one determinant is food access, if people cannot access food due to lack of affordability it means food security will not be met.

Lack of local market

Majority of respondents indicated that they are passive participants in the market, they are obliged to sell at low price immediately due to their lack of storage infrastructure and they pay high prices with no choice of negotiating proper prices. About 95% of respondents indicated that they couldn't improve their production due to lack of market access. Their rural areas are remote and far from urban areas where the buying power is. As a result, the high costs of transport are always a barrier to their access to markets.

The focus group agreed that lack of information on the market, no negotiating skills and experience also hinders their access to market. They indicated that due to lack of collectiveness, which could strengthen their power when approaching the market, they are always disadvantaged by the quality and quantity they take to the market. They reiterated that inability to market their products is due to lack of income for production inputs, immediate income and asset accumulation. This confirms what Aliber (2010) who stated that only the farmers who live close to market and better roads have more frequent and direct access to market, those living in rural areas only produce for domestic consumption.

6.5 HOW SMALL-SCALE FARMERS COPE WITH FOOD SECURITY IN THE MIDST OF CLIMATE CHANGE

As stated in previous discussions, small-scale farmers are aware that their climate is changing and they are also aware that the change has impacted food production in the past ten years; they also confirm that the Province is getting drier and temperatures keep on rising, with little or no rainfall leading to severe droughts.

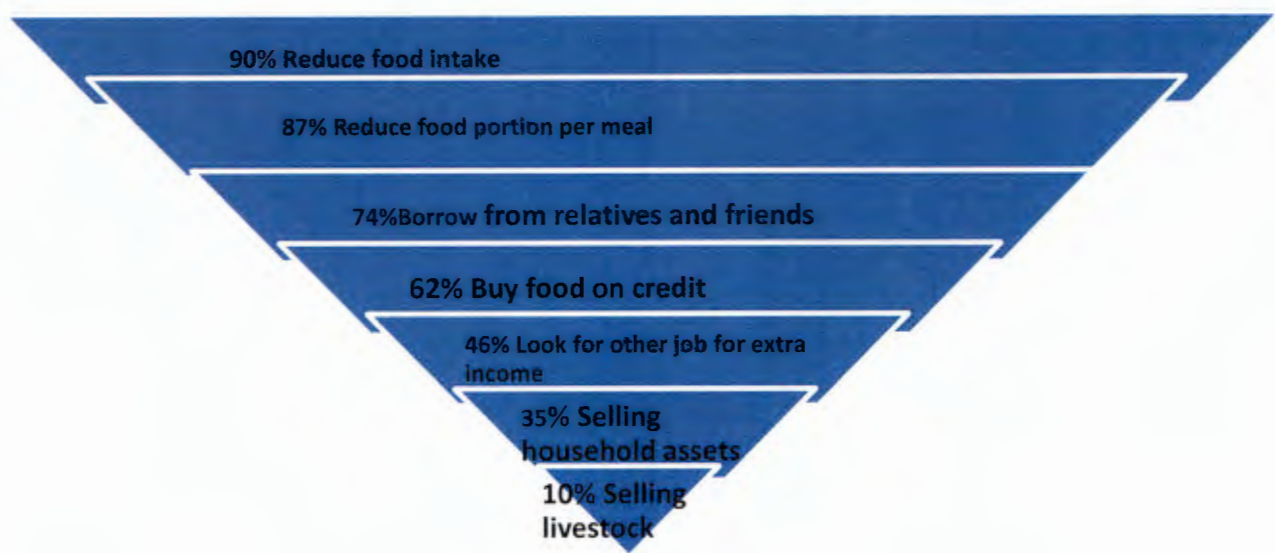
Several studies from across the world, also confirms that farmers are aware that the climate is changing and they need to prioritise it (IPCC, 2014). In South Africa and Limpopo in particular, studies have also shown that the physical impact of climate change has affected the lives of farmers negatively, meaning that adaptation is inevitable (FAO, 2014; De Cock, 2013; Mallikarjuna, 2013).

Figure 6.15 below outlines the strategies small-scale farmers mentioned in their responses. The most common ones are adopted by the majority of respondents and are placed at the top of the pyramid. Majority of respondents indicated that they reduce their food intake when they realise that they are

gradually running short of food, 87% indicated that they reduce the portion of food per meal and still this does not give comfort, as it is only a temporary remedy. 74% mentioned that they borrow food or money from relatives and friends and this is not sustainable as it can only happen once because if the food or money is not returned as promised, the relationship dies and conflict starts.

Buying food on credit is popular among respondents who also mentioned that it does not really help them but subject them to permanent indebtedness. While others opted for looking for other jobs to get extra income, finding employment is not as easy in rural areas and they have to leave and look for employment far in the urban areas.

Table 5.15 Coping Mechanisms for Food Shortage



Source: S.M Pheto (07/2017).

This often subjects them to family destruction if they do not find work. The unpopular strategies were selling household assets and livestock. Majority of small scale farmers do not favour this option as they feel that their assets are their only boost to their livelihood, they cannot be selling them for food, would not help, they would rather opt for other strategies.

6.6 BARRIERS TO EFFECTIVE ADAPTATION

Although farmers indicated that they have adopted some strategies to cope with the impact of changing climate, they also acknowledged that they could be doing better than that if it was not because of no affordability to some effective and costly strategies. De Cock (2013) shares the same sentiments. Even though farmers are committed to their food production and trying to force them up through the economic ladder, lack of capacity to adapt will always pull them down.

Table 6.16 Barriers to Adaptations

Identified Barriers to Adaptation
➤ Lack of water and Irrigation System ➤ Lack of financial resource ➤ Lack of equipment and production inputs ➤ Shortage of skilled Extension Officers ➤ Lack of education

Source: S.M Pheto (07/2017).

Lack of water and Irrigation System

Without adequate water, agriculture is doomed; without agriculture food security is non-existent. Majority of farmers cited lack of water and irrigation systems as their barrier to increasing their yield. They indicated that they even find it difficult to increase their gardens and livestock due to shortage of water. This disadvantages them, as they cannot compete in the market due to them not producing up to standard products. Research has shown that irrigation can be a solution to the impact of climate change (Gbetibouo, 2009; Brown, 2009; Bryant, 2009).

Lack of financial resources

Research has shown that farmers need financial assistance in order to adapt to the impact of climate change. The vulnerable small-scale farmers cannot afford to adapt due to their poverty level. Their lack of education is also an area that needs to be coupled with financial resources. They cannot afford to take themselves to agricultural colleges but somehow they could be capacitated with skills to be able to cope (Adger et al. 2009; Maponya, 2012).

Majority of farmers indicated that due to rising prices in agricultural commodities and food, they really struggle to improve their farming systems. They aspire to have mechanisation and afford the relevant technology that would assist them to improve, but they really need financial assistance to do that. Some indicated that even though there are funds and loans in financial institutions, they always do not qualify due to their records that show negative creditworthiness.

Others indicated that they are aware that the government gives some farmers the implements and mechanisation, but their terms and conditions are always such that the assistance benefits very few farmers. Studies confirm that without financial independence, small-scale farmers will find it difficult to cope with the effects of the changing climate (DAFF, 2014; Maponya, 2012).

Lack of equipment and production inputs

Research has proved that farmers with adequate production inputs, appropriate equipment and land available have all it takes for good production. Most of the farmers do not have the right equipment, some just do not have others cannot afford. Farmers indicated that they would appreciate farming equipment and production inputs as assistance from government in order to increase their production.

They mentioned that to buy a tractor, the retailers expect them to have a regular income or at least the financial statements of the farming business if it is registered should show positive creditworthiness, otherwise they run a risk of being duped by other commercial farmers who sell old and no repairable equipment (Adger et al. 2009).

Shortage of skilled Extension Officers

There has been a debate on the impact made by Extension Officers on the productivity of farmers (Wang, 2014). Although there is no consensus, the positive impact of agricultural extension officers is generally acknowledged. According to Rogers (2010) the bulk of the work done by Extension Officers should be on assisting small-scale farmers to improve yield and to grow in the industry. DAFF (2015) supports the explanation that Extension Officers have had a huge impact on the establishment of the middle category in farming called the Emerging Farmers. They maintain that those farmers do not just emerge; they emerge because Extension Officers identified their potential and assisted them to grow.

Even though all the farmers were aware of the Extension Officers, many indicated that they have had contact with them, although not all indicated that they visited them. Some of those who had contact with them had some reservations on the knowledge of Extension Officers on farming. They mentioned that the information about climate change on its own was supposed to be advocated by Extension Officers in their respective villages but they have not been visible. Some even suggested that government could increase the number or strengthen capacity in terms of climate information for proper advisory on climate forecasting (Madzwamuse, 2010).

Lack of Education

One character of small-scale farmers is that they reside in rural area, where poverty and low levels of education exist. Lack of education is a huge disadvantage to farmers. Even though they have accumulated experience over the years, the latest technology needs a minimum level of education. All farmers

interviewed have matric, which is a complement, however, they indicated that most of the magazines and brochures are written in English and Afrikaans and sometimes they do not comprehend what they are reading (Zwane, 2015).

6.7. EFFECTIVE ADAPTATION STRATEGIES FOR SMALL-SCALE FARMERS

One objective of the study is to identify Adaptation Strategies that could assist small-scale farmers and have worked for other farmers in developing countries. Since it is evident that small-scale farmers cannot cope or deal with the impact of climate change alone, there is a consensus that they need to be assisted to adapt.

The assistance can come in the form of human, financial and technological resources. To ensure that they fully adapt they should be trained and given more skills in order for them to be able to identify and assess adaptation options and their costs (Mbilingi, 2013).

As highlighted, adaptations in one area may not necessarily be suitable in another area, there are, however, adaptations that cut across and are commonly used. Even though small-scale farmers use adaptations they hear about from the radio or read from the newspaper, it is important to check with the Extension Officers in order to avoid unnecessary expenditure. If adaptation does not work or bear expected fruits, it should be stopped.

For instance, an irrigation system that is built in a village for small-scale farmers cooperative, which may need extra funding to maintain and repair, or need technical expertise to manage, should not just be erected, without building capacity and transfer of good management skills, otherwise it will end up as a white elephant (Mallikarjuna, 2013).

Strategies in Table 6.17 are recommended by farmers themselves and the government officials' interviewed. They also suggested how the strategies could be implemented. It is also comforting to discover that small-scale farmers were aware of some of the strategies but had thought they could not work in their own areas, but after discussion with the group and in an interview they acknowledged that with the assistance of government and other interested institutions, adapting to climate change should not be a hassle.

Table 6.17

LIMPOPO ADAPTATION STRATEGIES	
EFFECTIVE ADAPTATION STRATEGY	POSSIBLE ASSISTANCE AGENTS
1. Adjust farming practices	Government to provide training support through extension services
2. Integration of modern and indigenous farming practices	Government to integrate modern and indigenous practices in planning and policy
3. Improve water management practices	Government and traditional authorities to avail land to increase dams and support farmers with boreholes.
4. Crop diversification	Training should be provided through extension services
5. Switch to more climate tolerant crops and breeds	Training should be provided through extension services
6. Produce own fodder, and manure for fertilizers	Training by extension services and other commercial farmer mentors
7. Adjust planting periods according to climate	Information be provided by extension services
8. Adaptation of mixed farming	Training be provided by extension services
9. Improvement of livestock shelter and crop field	Small scale farmers with the assistance of extension services
10. Livelihood diversification	Government to create jobs in rural areas to enable small scale farmers to diversify their livelihood
11. Provision of new technology, equipment and farming inputs	Assistance of government will be needed.

Source: S.M Pheto (07/2017).

6.8 ROLE OF GOVERNMENT IN ADDRESSING RISKS AND CHALLENGES OF CLIMATE CHANGE

Agriculture remains the pillar of economic development and Limpopo government considers it as an important sector for food security, therefore it is government’s prerogative to ensure that services reach rural areas where predominantly people are poverty stricken. Some arguments are that even if government is providing support to small-scale farmers, people in rural areas are still sinking down to food insecurity. Although the department has good policies meant to alleviate poverty and promote food security, the distribution of resources is still very skewed and policies poorly implemented because of lack of adequate skills and capacity among implementers, and still others argue that even those who are lucky to receive financial assistance, normally not monitored to ensure that they grow (Ndleve, 2012, Obi, 2011).

Extension Officers are government employees in the Department of Agriculture who are tasked with the responsibility to work closely with farmers and provide services such as advisory services on where and how to get available financial services in the department. They also assess the farmers farming practices and provide seeds, fertilizers, pesticides and provide training and agricultural skills where necessary.

Table 6.18

ROLE OF GOVERNMENT IN ADDRESSING RISKS AND CHALLENGES OF CLIMATE- CHANGE
1.Financial support to farmers
2. Water management
3. Increase restrictions on water usage
4. Provision of farmer support programs
5. Capacity building on increasing farming production
6. Provision of accurate weather forecasts
7. Conduct research on soil samples for accurate planting of crops
8. Capacity building to manage risks on natural disasters
9. Development of policy to ensure mainstreaming of climate change in all its programmes and projects to encourage adaptation
10. Increase awareness campaigns to citizen on climate change

Source: S.M Pheto (07/2017).

They often coordinate joint ventures or partnerships with commercial farmers for skills transfer, climate advisory information and technical support. They are called field workers because the bulk of their work is technical support to farmers. They need to visit and guide rural farmers regularly to ensure that they are aware and utilizing improved farming technologies and services. They conduct practical capacity building and training to farmers. This is why it is important that the Department ensures that they appoint qualified and skilled personnel in this area (Mashamba, 2012)

Majority of farmers interviewed indicated that they would appreciate it if government could improve the capacity of Extension Officers and provide them with logistical resource that would motivate them to be effective in doing their work. Farmers indicated that more Extension Officers should be employed in order to cover the whole rural communities.

In a focus group discussion majority indicated that they understand that the extension officer's role is to;

- (a) Provide assistance to farmers by providing them with skills and training on how to apply fertilizers and pesticides.
- (b) They indicated that they coordinate financial assistance and joint ventures with commercial farmers for skills transfer, climate advisory information and technical assistance.
- (c) They also indicated that they discuss and share with them the programmes and opportunities offered by government.
- (d) They indicated that they assist farmers with whole farm planning and suggest suitable farming methods.

6.9 GOVERNMENT PROGRAMMES AIMED AT ASSISTING SMALL-SCALE FARMERS

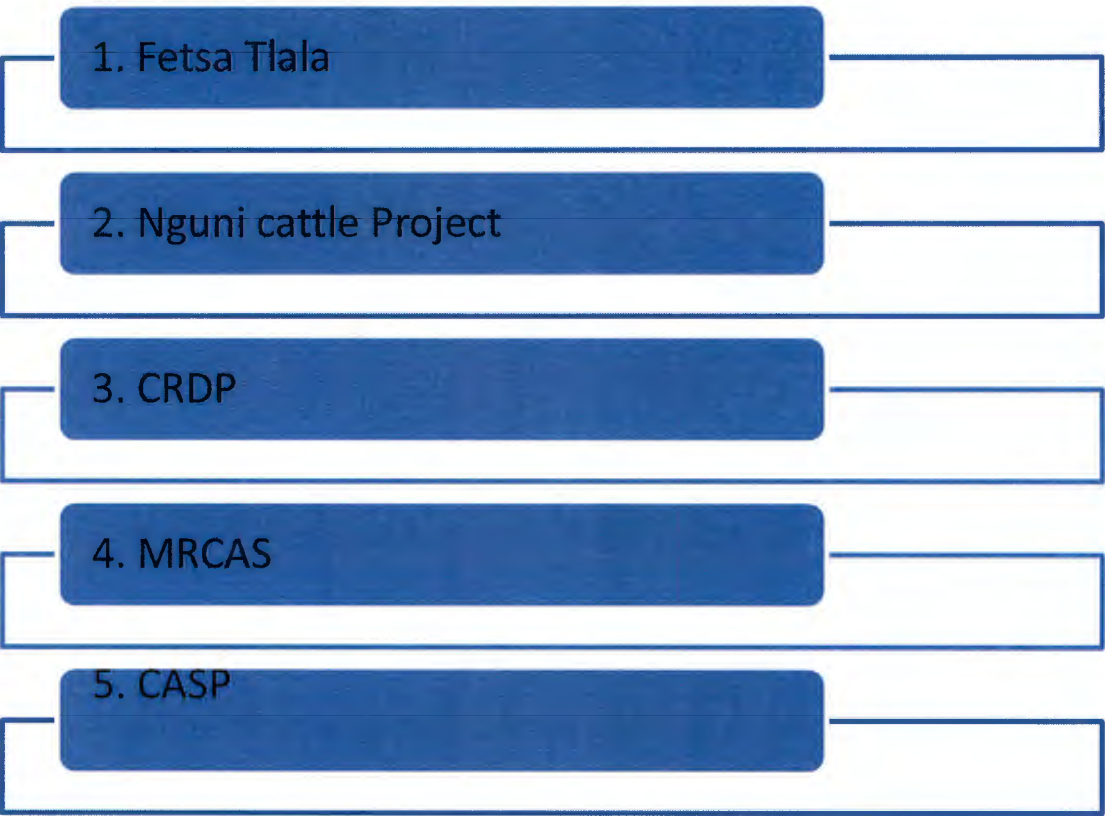
Government needs to strengthen its medium of communication with small-scale farmers in rural areas. Lately, government has improved its services and aligned them with new technology. Announcements are done through websites and social media networks. Small-scale farmers in rural areas miss more important information as they live in areas where development is very slow and people delay to get information.

Farmers indicated that they are aware of some of government programmes aimed at assisting small-scale farmers. Most respondents indicated that they are aware; however the beneficiary selection is always skewed and leaves most deserving poor farmers without benefits. They indicated that programmes such as Fetsa-tlala, which was aimed at promoting food security in rural areas is a good programme, but it is just a drop in an ocean, considering the number of small-scale farmers in the Province.

Some indicated that the terms and conditions to government programmes are always not favourable to small-scale farmers. For instance, for a small-scale farmer to qualify for Nguni Cattle Project, one needs to have specific size of land, and infrastructure to qualify. Most people in rural areas do not own land and any modern infrastructure but normal kraal for livestock.

Some farmers indicated that they are aware of the programmes such as Letsema and comprehensive Rural Development Programme (CRDP) but the application to government programmes takes a long time and only few farmers are catered for. They indicate that although government is trying to assist them, the arrangement of share mechanisation or form cooperatives in order to access assistance has not worked for them as other people do not cooperate and others are not committed to farming. That is why most cooperatives fail.

Figure 6.4 Government Programs meant to assist small-scale farmers



Source: S.M Pheto (07/2017).

Although the government of Limpopo have introduced programmes that are mainly intended to assist small-scale farmers, it seems they are far from reaching them. The focus group discussions on the programmes meant to assist them, farmers indicated that they heard of Mechanisation Revolving Credit Access Scheme (MRCAS), which was intended to assist small-scale farmers with mechanisation in order to improve their yield, but were disappointed when they found that the terms and conditions of acquiring mechanisation was not easy for small-scale farmers.

They indicated that the objective of that programme is still not met; instead more commercial farmers enjoy the benefits because they have land and their commercial status allows them to have a traceable

track record of productivity. However, small-scale farmers in rural areas do not qualify as they do not have collaterals (Aliber, 2010).

Another programme they raised concern about was Comprehensive Agricultural Support Programme (CASP), which they said is not properly administered by the department. This is another programme aimed at supporting small-scale farmers with farming equipment and services but the benefits fail to reach intended beneficiaries. Farmers indicated that the programme is dependent on Extension Officers even though Extension Services reach such a small number of small-scale farmers.

This response supports the investigation of Aliber (2010) and National Development Agency (NDA) (2012) when they complained that the problem with supporting small-scale farmers is not the budget but more of misallocation of funds through local offices, which has caused so many imbalances, in evidence between budget and impact made by this programme.

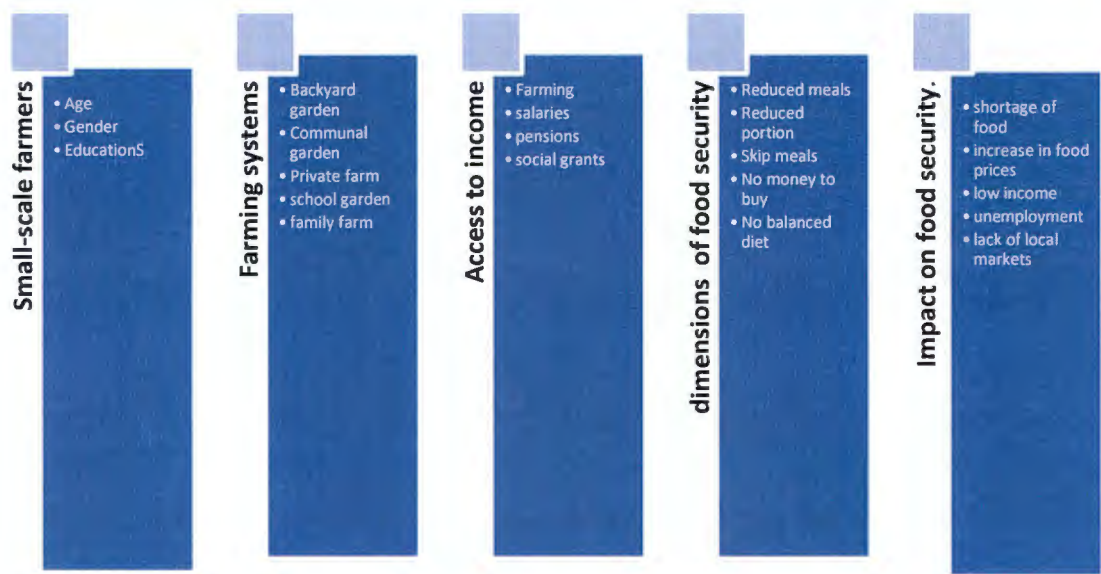
Since agriculture in South Africa depends on adequate weather, it the responsibility of government to ensure that people have enough water to enable them to produce more food. According to Department of Water Affairs (DWA) (2015), South African Government has taken an initiative to address water shortage throughout the country and these include:

- (a). To give those who have harvested water incentives, such as providing them with rainwater tanks. This has proven to have benefits especially for low-income earners. They save money that they would have used to pay municipality water supply. For others who do not have water supply, it saves them time to get water from the river or the communal tap especially for domestic chores such as washing clothes or dishes in the kitchen.
- (b). To create and improve on the water management systems. In most areas the infrastructure is worn out or not maintained as a result it causes unnecessary loss of water due to the leakages
- (c). To invest on water resources and water saving projects in the villages through to national level.
- (d). To invest on educating and advocating good water use throughout the media across the country. The impact of education and information cannot be overemphasised when it comes to persuading people to take action; therefore media notices or advertisements are being used to inform people about saving water.
- (e). To provide capacity to ensure that all people have access to safe drinking water, as mandated by the constitution.
- (f). To develop capacity to ensure that all catchment management agencies are effective and can be held accountable.

When water is well conserved and protected for sustainable use, it makes agriculture and all other food sources sustainable. So it is important to prioritise water when we talk of food security because for every food that we eat water must have played its part, either by producing food or by processing food.

6.10 THE STATUS OF FOOD INSECURITY IN LIMPOPO

Figure 6.6 Determinants of food security in Limpopo



Source: S.M Pheto (07/2017).

Identified determinants of food security in Limpopo are summarised from previous sections. Age, gender and educational levels were used to characterise the respondents who were all small-scale farmers. The findings from their responses confirmed that when farmers are educated to a level of diploma and degree, they are able to get an extra income through employment or engage in other off-farm activities that bring extra income.

This allows them to improve their farming needs and increase their production. Those who are less educated, do not easily find a job and they mostly depend on farming as their source of income, so during unreliable weather events, they are not able to adapt or improve their farming as they do not have extra income.

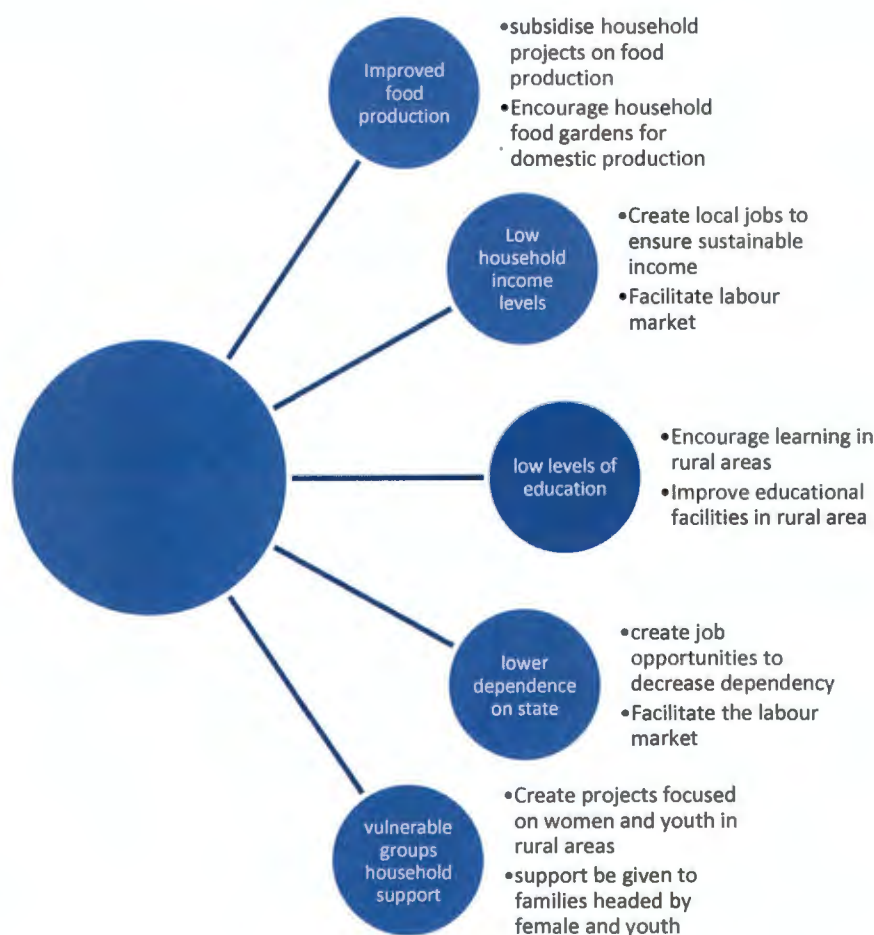
Majority of those who depend on farming, use their backyard gardens for farming activities. The findings confirmed that they farm on small land, which does not allow them to expand in order to make more income. Those who are on private farms and family farms are farming in bigger land and are able to diversify their farming. So an issue of availability of land has a relationship with expanded food security in rural areas.

Respondents who depend on farm confirmed that they do run out of cash to buy food in time of need. The implication is that during dry season when they do not produce much they are pushed to more extreme poverty, and need more food security than those who earn extra income. Those who earn salaries, pensions and social grants are able to buy food on credit or afford to augment their produce with purchased food.

Another dimension is that those who earn extra income are more able to pipe their own boreholes and have proper management of their own water, than those who rely on communal taps. The latter are easily affected by by-laws and water restrictions imposed on the entire community and therefore affect their production. In this way their food security is compromised.

The findings also confirmed that income and employment have an influence on good production. Those who have extra income have proved to have access to water supply while those who do not are often forced to buy water from neighbours, and this depends again on the availability of cash.

Figure 6.7 Findings for policy priorities



Source: S.M Pheto (07/2017).

Food security demands that people have all dimensions of food. The findings are that such food accessibility is compromised when over 80% of respondents run out of money to buy food, due to lack of purchasing power. This means that even if food is available in the market they are not able to access it. Findings indicate that farmers are not able to sustain food availability in their own backyard gardens. They need to produce more and make more income to give them power to purchase those that they do not produce.

Furthermore, the findings confirm that all respondents reduce their portions and number of meals due to shortage of food. Food utilization is therefore compromised. There is no doubt people are vulnerable to diseases related to shortage of food intake such as cholera, malnutrition and HIV/AIDS.

It has been confirmed in the findings that shortage of food is not only about what the food farmers produce but also about accessing the available food, which are becoming too expensive to afford. The principle of food security by Wlokas (2008) is that for people to be considered food secured, they should physically have food or be able to purchase desired food that will give them nutritious diet. In the case of Limpopo small-scale farmers, this has proved to be farfetched.

There are several policy priorities that can be drawn from the above findings that could somehow bring relief to the different challenges the people of Limpopo are faced with.

6.11. SUMMARY

This chapter outlined the status of insecurity in Limpopo Province. It started by explaining the profile of the Province and its characteristics. The intension is to get a clear view on what could be the opportunities and threats that can be addressed to manage the risk of climate change on food security. The status of education, human settlement, access to electricity, other sectors that build up to the economy of Limpopo such as mining, agriculture and tourism.

This chapter examined the livelihood of people in Limpopo, how they survive in terms of farming, employment and how they access food. The impact of climate change on the livelihood was also identified and unpacked. This included the shortage of water in most areas, in particular rural areas; high rate of unemployment, and very low income for the minority that is employed in different industries. Poverty levels that are perpetuated by shortage of land for majority of the rural people, makes it difficult for them to be economically viable.

It was also discussed in this chapter the impact of climate change on agriculture in relation to food insecurity of many households in this province. Climate change has contributed in reducing livestock in the province, which means most meat products are also affected in quantity and price. The crop production is also reduced and continues to be threatened by effects of climate change. It is also

surprising that more of agricultural farming commodities have also increased in prices, making it difficult for small-scale farmers to continue or improve their farming in order to adapt to climate change. It has also been discovered in this chapter that there is a new phenomenon of proliferation of diseases on plants and animals that are brought about by the changes in climatic conditions.

The chapter also discusses the impact of climate change on Limpopo's food security. It has been discovered that due to the effects of climate change, production of food has decreased causing shortage of food in the province. This shortage of food has influenced the increase in food prices as the demand for food has also gone high. This is negatively affecting those who are unemployed and those who are earning very little income as they cannot afford to buy high priced food therefore do not have access to some food.



Although Farmers in Limpopo face some barriers to their effective adaptation strategies such as shortage of water for households and irrigation systems, lack of financial resources to buy modern implements and diversify their farming practices, lack of equipment, mechanization and production inputs to maximise their profits they still continue with farming even when their production has gone very low. They also lack adequate and skilled extension services that can improve their knowledge and skills on farming and capacitate them on climate change, in most cases lack of education is a big barrier because even where books and magazines with relevant information are available people are not educated enough to comprehend them.

After identifying the barriers to adaptation the chapter highlights effective adaptation strategies that could be used by farmers with or without the assistance of government. They include, to adjust farming practices by integrating modern and indigenous practices, diversification of crops and animal breed, switching to more climate tolerant crops and animal breed, adjust planting periods to suit climatic conditions, adapt mixed farming, livelihood diversification and the use of new technology and farming inputs.

This chapter also deals with the role of government in assisting the farmers to manage the risks of climate change. It has been identified that the role of government as stipulated in the Constitution of South Africa is to create a conducive environment for all citizens to have a better life. Therefore, to achieve this goal, government has a mandate to financially support farmers in their efforts to produce food. It has the responsibility to conserve and manage the use of water, even to impose some restrictions through policy where it is necessary. It is also the duty of government to make sure that farmers are capacitated, given programmes that support them such as the Fetsa Tlala, Nguni cattle projects, Comprehensive rural development programme and many more; that are meant to assist farmers to improve their livelihoods through good farming.

This chapter also outlines the role of government as making sure that farmers get accurate weather forecast, research on different aspects of farming such as research on soil samples; and create policies that will mainstream climate change into its projects and programmes. It is also important to make sure that there is enough awareness and capacity to manage natural disasters in order to manage the effects of climate change.

This chapter also identifies areas where government should prioritise its policy in so far as climate change impact on food security is concerned.

CHAPTER SEVEN

THE STATUS OF FOOD INSECURITY IN THE NORTH WEST PROVINCE OF SOUTH AFRICA

7.1 INTRODUCTION

North West is one of the food baskets of South Africa and yet it is amongst the smallest Provinces. Most of the country's maize is produced in the Province. It is estimated that about 65% of the population in this Province lives in rural communities while only 35% lives in urban areas. Due to high poverty and unemployment, most people migrate to urban areas. Agriculture is one of its main employers and has a potential to sustain its food security. However, the Province is also frustrated by the impact of the changing climate, which is discussed in the following sections of this study (NWPG, 2015).

The purpose of this chapter is to give an overview of the North West Province. It covers the responses to the study questions on the impact of climate change in the Province, how small scale farmers are affected by the impact, and how they cope under the circumstances. The barriers to effective adaptation and identified adaptation strategies are discussed together with the role of government in sustaining food security in the Province. This leads to the overall status of food insecurity in the Province as analyzed by the respondents and other literature resources.

7.2 PROFILE OF THE NORTH WEST PROVINCE

Situated at the northern part of South Africa, North West Province shares borders with the Free State, Limpopo, Northern Cape and Gauteng. It again borders with Botswana to its North. With a population of 3.5 million, the Province covers about 106 515 kilometre square. It is divided into four districts namely, Bojanala, Ngaka Modiri Molema, Dr Kenneth Kaunda and Dr Ruth Segomotsi Mompati. Majority of people living in the North West are black African and they account for 89.8 percent of the population.

The North West Province was born out of a merger between Bophuthatswana Black Homelands and the Western Transvaal of the Apartheid Government in 1994. The Province is 64% rural.

The Province is mostly flat, with savannah and grassland biomes. Its climate varies throughout the four seasons. The Eastern Regions are much wetter, Western parts drier and hotter. Summer in the North West comes between August and March and temperature at 22 to 34 Degree Celsius. The low levels of rainfall in the Province create a threat to the North West population. The patterns vary from one area to the other. Some areas in arid areas receive 300mm of rain per annum and semi-arid areas get 500mm of rain per annum. The eastern part of the Province receives more than 600mm per annum. With such patterns, the consumption of water by mining industry, agriculture and domestic use will need the Province to invest in the upgrade of water management and water resource infrastructure.

The map displays the Tlokweng Local Municipality, which is divided into four districts: Bojanala Platinum (blue), Dr Kenneth Kaunda (green), Dr Ruth Segomotsi Mompati (red), and Ngaka Modiri Molema (dark green). The map also shows the boundaries of various local municipalities, including Ramotshere Moema, Masekeng, Kgetlengrivier, Rustenburg, Moretele, Mafikeng, Tlokweng, City of Mmofana, Venterdorp, Tswang, Ditsobotla, Kallou, Naledi, Mamusa, Lekwa-Teemane, Greater Tsung, and Kagisano/Molopo. A scale bar indicates distances of 0, 50, and 100 Kilometers, and a north arrow is provided for orientation.

Winter comes in May until July with average temperature of 16 Degree Celsius. Sometimes winter falls below 2 Degree Celsius or climb as high as 20 Degree Celsius depending on climatic change. Observations and predictions state that high temperatures have increased in frequency and low temperatures have decreased. Its annual rainfall trends are also weakening particularly for the autumn months (DEA, 2013).

Agriculture is used extensively in the Province, either by commercial farming with irrigated cultivation, livestock farming and game farming or subsistence farmers for small income and domestic consumption. It also contributes to 8% of its employment. About 43% of the land is arable so livestock and game farming happens mostly in the drier parts of its west. The central and southern parts are dominated by maize and wheat crops. In the east and northern part of the Province, varieties of crops are mostly produced (NWPC, 2013).

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provincial employment (Cloete and Idsardi, 2012) and this is an indication that agriculture plays a major role in sustaining rural economy in the Province.

According to NWPC (2013b), although commercial farming is holding agricultural produce in the province, agricultural irrigation by commercial farmers is also contributing to the shortage of water in this Province and predominantly it relies on ground water. Although agriculture is essential for food security, it also threatens the availability of fresh surface water. Agricultural chemicals used during farming are major polluters of surface water and underground water, through runoffs and infiltration, and soil

Table 7.1 Relevant Biographic characteristics information of the North West Province

INFORMATION	FIGURES
1. Size	106512 km square
2. Population	3.5 million
3. Rural nature	64%
4. Unemployment levels	31.5
5. Poverty levels	8.2
6. Those receiving salaries	54.4%
7. Those receiving grants	25.9%
8. Female headed families	33.3%
9. Hunger in households	14.7
10. Small holder livestock	91.5
11. Crop production	11.3
12. Fruit production	11.4
13. Access to food	32.9

Source: S.M Pheto (07//2017).

erosion. Most of the irrigation dams, weirs and water canals disrupt the flow of surface water as the water is often redirected.

Like many other parts of South Africa, North West Province, rising temperatures and changes in precipitation have become a threat to food production. Agriculture is faced with the negative impact of climate change and this poses a challenge to livelihood of the majority of rural communities which are already vulnerable to food insecurity.

According to Department of Agriculture and Rural Development (DARD) (2014), small-scale farmers in this Province are affected by the failure of seasonal rainfall and extreme weather events. Their food production has also dropped as they are unable to adapt to the effects of climate change. However, the

commercial farmers in this Province though affected, are better because they are able to adapt, even on a small scale. They use irrigation systems and technology to adapt.

In the North West Province the main driver of sustainable water is rainfall and its location makes it vulnerable to the rate of evaporation as it is predominantly arid. With changing climate on the rise, the determinants of water resource quality and quantity are rising by the day, and it increases incidents of water-borne disease. Cloete and Idsardi (2012) agree that rural areas of the North West where agriculture is the main economic activity accommodate 65% of provincial population which then suggests that agricultural sector is very crucial for sustainable rural economy.

7.2.2 Water

Availability of water in the North West depends on the population, climatic conditions and economic activities taking place in the province. The increasing population coupled with mining and agriculture that relies on water is the clear indication that there is a need to increase water availability. Water availability in the province is the responsibility of all spheres of government, with the Department of Water and Sanitation (DWS) as the overall custodian of water resources in South Africa, as governed by the National Water Act (Act 36 of 1998).

McCarthy (2011) indicates that although access to safe water is a basic right in South Africa, to some people living in the rural North West areas, access to water is still a challenge. North West water is unevenly distributed to people staying in urban and rural areas, with more water going to the urban areas where there is service delivery. Most rural areas do not have supply of water. More people migrate to urban areas in search for a better life, and they increase the population and the demand of water goes high especially the mushrooming of informal settlements that were never part of the urban developmental plans.

Shortage of water in this area causes poor sanitation and increases pressure on water infrastructure such as sewerages and their purification plants. This is one of the reasons why the state of water infrastructure is so bad in the Province that most of the infrastructure was installed during the Bophuthatswana days when the population was very small and demand for water was met. The resources are now very old and needs to be replaced or upgraded (DWAF, 2010).

More of the challenges of farmers in the Province about shortage of water are that, while they struggle to get water for household, they also have a challenge of water to give to animals, as a result in most areas people are forced to share drinking water with animals.

Another challenge that the Province has is the lack of proper management of water resources. In most areas where people occupy land illegally, they engage in illegal connections and nobody takes

responsibility of leaking pipes resulting in more water being lost. Many rural communities in the North West have to be educated to take care of water since it is now becoming their scarce resource.

In the past five years there has been several demonstrations of dissatisfaction due to shortage of water in most areas in the North West, in particular the Madibeng Municipality in the far east of the Province. Ngaka Modiri Molema also was sparked with protests on the shortage and quality of water that was associated to old water infrastructure that is not well maintained (NWPG, 2011).

Fig. 7.2 Villagers share drinking water with animals, S.M Pheto (07/2017)



According to North West Provincial Government (NWPG) (2015), the Province still has backlog of 20464 houses that are without proper access to water and 250 000 households without proper sanitation. Another challenge stated by North West Planning Commission (NWPC) (2012) is the lack of water delivery due to aging infrastructure. This has been influenced by non-cooperation between different affected institutions such as the municipalities and water supply institutions (Water Boards).

The big issue as identified by NWPC (2015) is lack of technical skills and human resources. These differences affected the billing systems of water supply. For instance, in most households or street, water supply pipes would leak due to non maintenance, and the consumption would be disputed by the consumer due to meter reading disputes. However through its water provisioning and management plan, the Province is dealing with its water related challenges.

According to NWPG (2015), the province is addressing the sustainable use of water resources in its Water Provisioning and Water Management Plan, which seeks to manage sustainable balance between water availability and water supply for a long time. It emphasises water conservation and demand management;

and water recycling and re-use. On the other hand the province is implementing the North West Ground Water Master plan (DWAF, 2010) that defines the tasks for ground water management in the province, that is, information in terms of utilization, protection, management, control and data management.

It is against this background that the status of water availability in the province is found to be declining due to poor management and basic limit to resources and failing infrastructure. Water quality status although acceptable in both ground water and surface water, the dams which the supply relies on seem to be deteriorating at a higher rate than expected due to high temperatures and lack of rainfall, therefore it is critical for the province to look for other alternative sources of water, address the deteriorating water quality status of dams, invest in upgrading aging water supply infrastructure to improve water service delivery backlogs in rural areas; and implement sustainable use of water resources as outlined in its Water Provisioning and Water Management Plan.

7.2.3 Human settlement and infrastructure

There is a relationship between human settlement, their livelihoods and environmental change. As they grow over the years they impact on the natural resources such as water, energy, land etc. As indicated earlier that the population of the North West Province is about 3 509 952 which reflects about 6.8 of the national population, however, there is migration into the Province due to perception that because there are mining areas in the North West there is more job opportunities in other areas. The urban areas accounts for 44% of the population in the Province (DEA, 2012).

The urban areas of the North West are associated with economic growth, high levels of education and employment, therefore local and international migrants rush to the urban areas. Most people come to the urban areas without any accommodation or prospects of investing in property, however they settle in informal dwellings at the backyard of other people or they erect illegal squatter camps just near the suburb areas.

The urban areas are run by municipalities and their service deliver is well planned and budgeted for. But the pressure put on the municipalities by illegal dwellers is that the cost of the service delivery becomes very high and nobody wants to take responsibility for it. Additional population to local one demands more resources and produces large waste and pollution that alters the normal service delivery programme (NWPC, 2013).

This does not mean that rural areas are better off as bigger population moves to urban areas. Rural areas are most vulnerable in terms of access to basic services such as water, electricity and sanitation. According to Stats SA(2013), major growth has taken place in the Bojanala District while the major decline took place in Klerksdorp in the Dr Kenneth Kaunda District.

This can easily be attributed to the change of mining activities in both districts. As most of the mining companies in Klerksdorp close shop, most companies opened new mines in the Bojanala region. About 46% of the population resides in tribal and traditional areas and only 9% stays on farms.

Since 2001 to date, North West Province has been constructing houses to improve the quality of the lives of its people. However due to limited available land, insufficient funds, unreliability of contractors and illegal occupation which ends up taking much of government money and time for legal disputes, the Province has reduced the construction of houses.

The impact of human settlement on availability of natural resources such as water, food and shelter is the pressure that is put on these resources by the growing population (Krisjan, 2013). For example human activities generate waste, through disposal of waste products. The accumulation of waste causes pollution of natural resources. This scenario has a great potential to aggravate diseases and therefore puts strain on the health system. This means that with the growing population, more waste and more diseases, the province is challenged to find better ways to manage these effects of climate change.

Challenges that North West has with regard to managing pollution posed by lack of waste management include, shortage of human and financial resources especially in local municipalities, inadequate collection of waste and lack of management of waste minimisation initiatives (NWPG, 2014), however Department of Economic Development Environment, Conservation and Tourism (DEDECT) (2012) and Department of Environmental Affairs (DEA) (2012), highlights that with appropriate institutional systems in place, waste can be turned into a resource within economy in the province.

North West Provincial Government (2015) acknowledges that the province has a challenge to reduce and mitigate poor environmental resource use and sustainable consumption of growing human settlements, on one hand there is a dire need to address the social and economic obligation to provide housing, infrastructure and services, which will improve the quality of life. Through its policies and programmes, the province intends to respond to the challenges of human settlement in a manner that would not compromise the availability and quality of natural resources.

7.2.4 Electricity

Nationally, 71% of energy is produced from coal and crude oil, 63% of the electricity in the Province is used by mining industry. On the other hand mining contributes to more emission than other industries in the Province. Other than mining, electricity is used for lighting, heating and cooking. Otherwise some people in the rural areas use paraffin and candles for lighting (DEDECT, 2012).

Most people in urban areas have electricity, however in most illegal dwellings people have made illegal connections of electricity and this reduces the revenue for electricity. Another problem that the Province

has with regard to electricity is the theft of copper cables. This always causes disruptions to service delivery and economic growth as a whole.

However, more people are concerned that electricity rates are too high, especially for people who are low earners or those depending on social grants (DEA, 2012). Despite Eskom supplying communities with electricity, the use of domestic fuels such as paraffin, wood, gas and animal dung for cooking is still prevalent in most villages. In the Province, paraffin and wood are the most common domestic fuels for cooking (Griffins, 2012).

Fig.7.3 Poor people still use firewood to prepare their food in rural areas.



However, the number of households using electricity has increased over the years and this has also reduced the risk associated with burning domestic fuel such as spread of fire in burning squatter camps, polluted air, and risks to pollution associated diseases such as tuberculosis, asthma, lung cancer and other respiratory diseases (StatsSA, 2012).

7.2.5 Economy

North West is rich in mining and depends on its plantinum as well as agriculture, manufacturing and construction. The provinces' economy is dominated by mining at 30%, construction and agriculture at 2% and manufacturing at 3%. This economy is highly threatened by the decline in mining commodities, and the prolonged mining strike that took place in 2013 has made it difficult for the industry to recover, instead it has called for more retrenchments. Despite the difficulties that may have overshadowed mining

in North West, it remains blessed and rich with platinum, coal and diamond mines in the areas of Rustenburg and Klerksdorp, which have the potential to influence more economic activities in those areas.

According to NWG (2016), 162 000 people were employed in mining, 72 000 were employed in manufacturing, 64 000 working in construction while only 55 000 were in agriculture. North West province also has high levels of unemployment and has accommodated more migrants due to mining areas; this has increased its population and scarcity of resources.

Although North West does not have metro areas, it has four secondary cities (Mahikeng, Potchefstroom, Rustenburg and Klerksdorp) that support its economy. The province is blessed with a number of traditional communities that are active participants in the economy. The best known are the Royal Bafokeng Nation and Bakgatla ba Kgafela Tribal Authority. They own diverse holdings of more than 25 companies ranging from telecommunications to assets worth billions.

They have two huge stadiums that participated in the world cup. Because they are in rural areas, their complex share ownership and black empowerment deals have benefited the black rural economy. According to NWPC (2013), mining rights and greed for minerals have led to tension and court disputes between companies and communities however, the mineral wealth of these areas presents a great opportunity for the upliftment of poor rural people.

North West has variety of tourist attraction to boast about, that contributes to the provincial economy. Hartebeesdam is one ecotourism feature that brings many people into this Province (NWPG, 2013). The south of the North West is the Kenneth Kaunda District where Vredeford Dome World Heritage is situated and a number of coal and gold mines in the Orkey and Stillfontein areas. At Ruth Segomotsi Mompati District, there is Taung Heritage site, where the Taung skull was first discovered, this area attracts many tourists and geologists as it is listed as fossil hominid site of South African Heritage (Cloete and Idsardi, 2012).

At the centre of North West in the Ngaka Modiri Molema District, there are key features that influence tourism and economic growth such as Barberspan Bird Sanctuary Ramsar Site where many different bird species are found. Mafikeng, the capital town of the North West is a seat of Provincial Parliament and Provincial Government Head offices are situated in this district.

Major tourism assets include the Pilanesburg National Park and Madikwe Game Reserve with several surrounding luxury hideaway lodges. The entertainment centre and casino at the Sun City and the lost city make a huge economic boast to the Province. Tourism will remain one of the Province's economic pillars due to its natural resources and landscape features (NWPC, 2013).

7.3. DEMOGRAPHICS OF RESPONDENTS

Table 7.2 Sample in the North West Province

VARIABLE	MALE	%	FEMALE	%	TOTAL
North West	7	28%	18	72%	25
Total	14		31		45

Source: S.M Pheto (07/2017).

(a). Gender

Small-scale farmers were purposively selected to participate in this study. About 72% of the respondents were women and 28% were men. More women than men were selected in this study because of their accessibility to the researcher. Women were more willing to participate in the study and were found to be more in numbers than their male counterparts. Mokwena (2008), confirmed this situation when categorizing female farmers in the North West Province. Women were categorized as those who are female farmers and head households because the male partners are permanently absent, mostly because of separation or death.

Fig.7.4 Female farmers participated in the Focus Group in Taung, 06 July 2017.



Source: S.M Pheto (2017).

In some farming households male partners are temporarily absent because they opted to take other jobs outside farming, often because of labour migration Other households take a collective decision to have the female farmers active and have all the time to do farming activities when the husbands are busy with other family chores. Out of twenty five (25) participants from the North West Province, eighteen (18) were female farmers and seven (7) were male farmers.

(b). Age

Table 7.3 Ages of Respondents

AGE	TOTAL	PERCENTAGE
25 – 35	4	16%
35 – 45	6	24%
45 – 55	10	40%
55 – 65	5	20%
TOTAL	25	100%

Source: S.M Pheto (2017).

The study selected participants who are matured enough to understand the requirements of the information needed, therefore the age of the interviewed ranged from 30 to 65. Majority of respondents (84%) were older persons. The motivation for selecting this age scale is due to the fact that older and matured people often tend to show more commitment and knowledge, especially in labour intensive activities such as farming.

(c). Table 7.4 Levels of Education

EDUCATION	TOTAL	PERCENTAGE
MATRIC	20	80%
DIPLOMA	3	12%
DEGREE	2	8%
TOTAL	25	100%

Source: S.M Pheto (2017).

Age determines commitment and perseverance in agricultural practices. About 16% was constituted by younger people. It is believed that young people tend to find it more of dirty job and time consuming; only those who believe in farming with emerging farmer spirit show some interest in farming.

Table 7.4 shows that 80% of respondents have senior certificate (Matric). Even though they reside in rural areas they acknowledge the importance of education particularly for agricultural purposes. About 12% of respondents have college qualifications, while only 8% of respondents have University degrees. According to StatsSA (2015) more people in rural areas have basic education; this is attributed to the fact that rural areas do not have institutions of high learning such as colleges or technical institutions. People in rural areas are faced with low levels of education and development.

It is stated in the literature review by several researchers that lack of education in rural areas disadvantages people in those rural areas. It is important for them to know how to read and write so that they understand the manuals in various farming equipment and measurements to substances such as pesticides, insecticides, medicines for animals and plants. All respondents have senior certificate (Matric) and twenty percent have tertiary qualifications.

(d). Table 7.5 Types of Farming

TYPE OF FARMING	TOTAL	PERCENTAGE
Backyard garden	10	40%
Communal garden	4	16%
Private farm	2	8%
School garden	-	0%
Family farm	9	36%
TOTAL	25	100%

Source: S.M Pheto (2017).

According to StatsSA (2014), in the North West Province, most agricultural households in rural areas are mainly involved in subsistence and small scale farming. In most households there is often limited access to basic services such as water and electricity. Most of them are unable to expand their farming activities due to shortage of land for crops or grazing land for livestock. However, 40% of respondents indicated that they use the backyard gardens as they are easy to manage more especially in this era where there is shortage of water; they share the household water with their garden. About 36% use their family farm to

produce food but indicated that although it is difficult to access funding because they are not sole owners of the farm, they had to rely on agriculture as source of income.

Table 7.5 also shows that 16% use their communal gardens where they sort permission from their tribal authority. As researchers have already indicated in the literature review, most small-scale farmers are discouraged by the impact of the changing climate above all other stresses they have, that of shortage of water, shortage of land, low levels of income, and farming capital. It will be necessary to consider the type of farming in order to identify the suitable adaptation strategy to adapt to climate change (Mbusi, 2013).

(e)Table 7.6 Sources of Income

SOURCES OF INCOME	TOTAL	PERCENTAGE
Farming	8	32%
Salary	6	24%
Pension	5	20%
Social grants	2	8%
Other	4	16%
TOTAL	25	100%

Source: S.M Pheto (2017).

Table 7.6 shows that only 32% of respondents depend on farming as a source of income. Even though Agriculture is a determinant of income in rural areas, more have started to diversify their life styles due to reduced crop yield because of the impact of changing climate. Almost 68% of respondents do not entirely rely on farming for income.

It is evident from the responses that although farming sustains them in terms of food production, it is no longer enough to be the sole income as the productivity has reduced. From the literature review it was confirmed that agricultural production in rural areas is very low and the effects of climate change needs them to urgently find other sources of income to augment their farming income to curb food insecurity (Delgado et al. 2010).

(f) Water Availability

Table 7.7 Water Availability

NORTH WEST PROVINCE								
SOURCES OF WATER	QUALITY				QUANTITY			
	Good	%	Bad	%	Abundanc e	%	Shortage	%
Tap water	6	24%	10	40%	-		16	64%
Piped borehole	4	16%	-		-		4	16%
Communal tap	-		3	12%	-		3	12%
River	-		-		-		-	
Other sources	-		2	8%	-		2	8%
TOTAL	10	40%	15	60%	0		25	100%

Source: S.M Pheto (2017).

According to studies conducted in the Province, there are issues with regard to water availability and the quality which is always compromised. One of the key challenges of water supply in the Province is old infrastructure and water management. Shortage of water in the North West has been one of the causes of service delivery protests where rural communities were seen disrupting other services in order to get the attention of the government. About 20 464 households are reported to be without proper access to water. Water quality in the Province is a really bothering issue and it is attributed to domestic, industrial and mining effluents. Agriculture and storm water run-offs also pose a threat to the quality of water (NWEQ, 2013).

Table 7.7, Majority of the respondents reflected on the unsatisfactory picture of the quality and quantity of water in the Province. All respondents indicated that there is shortage of water in the Province. While 64% of respondents access water from the taps, they indicated that the quality of water they receive is bad; they indicated that sometimes the water comes out very dirty and with a bad smell.

Others still stated that they sometimes spend more than a week without water and there is often no clear explanation from the municipality why there is no water. About 16% of respondents who have piped boreholes indicated that although the quality of water is not bad, they are worried that somehow the quantity of water underground is decreasing as the pressure of water pumped gradually slows down. They are worried that they will end up with no water, especially now that there is scarcity of rainfall.

In table 7.7, 12% of respondents that use communal taps indicated that the quality of water is bad and the water is always scarce. They indicated also that they have to ensure that they have a proper storage of household use and keep some for animals because the local dams have dried out. Only 8% of respondents

indicated that they literally buy water from the neighbouring farms for household and livestock. Lack of rainfall has put them under immense pressure due to the rural nature of their areas there is no water supply, they have requested assistance from the municipality but they were only given promises.

There is a consensus even in the focus group discussion that rising temperatures, lack of rainfall have affected water resources negatively. They even agreed that the changing climate has affected the quality and quantity of water, increasing incidents of water-borne diseases, and concentration of salts and nutrients in water and soils as soils which dry without proper supply of water will fail under the changing climate.

There is even enough evidence to draw a conclusion that the rural nature of their areas also suggests that development and service delivery will come very slow to them, while at the same time extreme weather events such as droughts are threatening their lives. It even becomes difficult to talk about food production when they struggle with water.

(g) Table 7.8 Food availability, accessibility and utilization

NORTH WEST PROVINCE		
IN THE PAST TWELVE (12) MONTHS	TOTALS	%
Ran out of money to buy food	18	72%
Gone hungry when there was no food	-	0%
Had to reduce food portions because food was not enough.	20	80%
Not had balanced diet in your meal	25	100%
Had to skip meals because there was not enough	20	80%

Source: S.M Pheto (2017).

In Table 7.8, 72% of respondents indicated that it is true that they do run out of money to buy food, but they often borrow from neighbours and family until their situation has changed. It is encouraging to note that no respondent confirmed that they had gone hungry when there was no food; however most respondents stated that although they had run out of food, they always depended on other sources to enable them to buy food. As much as 80% of respondents indicated that when their food source is reducing, they reduce the portion of food they serve or skip some meals. Instead of having three meals a day, they only have two meals a day.

As shown in Table 7.8, all respondents indicated that due to shortage of food they produce and income they make, a balanced diet is often a luxury; most households just eat what is affordably available. However the majority acknowledged that the food they produce is no longer enough, as a result they always have to augment what they produce with purchasing some.



They also indicated that due to reduced local markets they are no longer making enough income and so purchasing food has become stressful, particularly with rising food prices. They also confirmed what was reflected in the literature review that households that have at least one person employed, or on pension or receiving social grant are better off as they bring some relief to already stressed food production.

7.4. IMPACT OF CLIMATE CHANGE ON FOOD SECURITY

North West Province is said to be 64 percent rural, therefore it has all the characteristics of rural Provinces that are stressed by poverty, low levels of education and unemployment and slow service delivery. Although some researchers claim that South Africa is food secured, some studies have shown that people living in rural areas are more vulnerable to the effects of climate change as well. North West Province is disadvantaged by its location, which is predominantly arid, and the rate of evaporation is high.

The rising temperatures and lack of rainfall have caused droughts in the Province. More continue to lose their livestock to drought and crops are failing due to lack of rainfall. Food production has gone down, so much so that many people, including farmers, are now buying food more than producing their own.

7.4.1. Small-scale farmers' perception on climate change

Majority of respondents indicated that they were aware that there is a change in climate. They have observed the rising temperatures that manifested into heat waves and veld fires their destroyed farms and left people and livestock stranded. Some also confessed that they have never seen drought taking so long in their lifetime. Most of the small-scale farmers had to sell their livestock because they could not keep them when they could see them suffering from hunger and diseases.

In a group discussion it was agreed that lately it has become very difficult for farmers to predict the weather like they used to do. They also reported their frustration for lack of water, which makes it more difficult for them to produce food. All the respondents were aware of climate change and agreed that the rate at which climate is changing needs everybody's effort to adapt.

Shortage of water

It is evident from Table 7.9, that small-scale farmers are troubled by the shortage of water in their areas. All respondents indicated that there is shortage of water in the North West. Since they rely on rain fed agriculture to produce food, lack of rainfall and changes in its pattern thereof are a huge disadvantage to the small-scale farmers.

7.4.2 Climate Change impact on Small-scale farmers’ livelihood in the North West Province

Table 7.9 Climate change impact on Small-scale farmers’ livelihood in the North West Province

VARIABLES	FARMERS	PERCENTAGE
Shortage water		
Yes	25	100%
No	0	0%
Low income		
Yes	23	92%
No	2	8%
Unemployment		
Yes	22	88%
No	3	12%
Poverty		
Yes	25	100%
No	0	
Shortage of land		
Yes	23	92%
No	2	8%

Source: S.M Pheto (2017).

Most small-scale farmers struggle to get quality water for domestic use and so they have even resorted to buying purified water. The focus group discussed and agreed that shortage of water is a general problem. They even decided to request assistance to dig more communal dams that would help them to store water during rainy seasons.

As Deonaria (2014) stated shortage of water in rural areas will make it impossible for farmers to produce food but instead force them into employment outside farming to afford food. It is evident that without water small-scale farmers will fail to provide rural communities with water.

Low income

The figures in Table 7.9 show that 92% of respondents have low income, which comes as a challenge because they struggle to produce and access food. They indicated that they travel to towns and markets to purchase food, which are highly priced. Since their rural areas are so isolated, they are forced to pay costly travelling fees in order to access food.

Unemployment

As reflected in Table 7.9, 88% of respondents mentioned that due to climate change and its impacts on their food production, other agricultural labourers such as shepherds, and fruit and vegetable vendors had to lose their jobs when farmers reduced the number of livestock due to the impact of climate change.

In the discussion group, it also appeared that some labourers were forced to leave their families and look for jobs in urban areas and this destabilised the families as not everybody got jobs, others no longer came back home. When people are unable to produce food and cannot afford to buy food, the implication is that they will sink in food insecurity. This is evident to what was expressed by Neves and Du toit (2013), when they stated that rural communities are characterised by unemployment that prevents them to adapt effectively to climate change.

Poverty

Even though farmers depend mainly on crop and livestock farming, they need other sources of income to curb food insecurity during unfavourable extreme weather events (Neves and Du Toit, 2013). All respondents agreed to living in poverty. They mentioned that when production fails due to precipitation and high temperatures, people are forced to look for off-farm jobs or face poverty. In rural areas there is no employment, as a result people when they fail in farming they fall in to poverty.

Most people living in poverty do not have entitlement and rely on handout from other people. Bad weather has caused other families their dwellings during floods and storms, and this had driven them into poverty, as rural homes are often not insurable. It is evident from what was reported by IPCC, 2014 that poor communities are more vulnerable to the impacts of climate change, hence the initiative to ensure that countries agree to prioritise them.

Shortage of land

As indicated in Table 7.9, 92% of respondents indicated that they are disadvantaged by shortage of land to increase their productivity. Some indicated that their choice of farming is limited to the small space, which confines them to do crop farming only. It confirms what Madzwamusi expressed about producing less because their rural set up is such that the land is either under tribal authority or municipality and none is willing to sell.

There is enough evidence to draw the conclusion that Intergovernmental Panel on Climate Change Report was correct to conclude that the following impact is felt due to the changing climate. (a) Shortage of water, (b) Low income, (c) Unemployment, (d) Poverty, and (e) Shortage of land (IPCC, 2007).

7.4.3 Climate Change impact on small-scale farmer’s agriculture

Table 7.10 Climate change impact on small-scale farmers’ agriculture

VARIABLE	FARMERS	PERCENTAGE
Reduction in livestock production		
Yes	21	84%
No	4	16%
Reduction in crop yield		
Yes	17	68%
No	8	32%
Rising costs of farming commodities		
Yes	25	100%
No	0	0%
Increase in diseases		
Yes	19	76%
No	6	24%

Source: S.M Pheto (2017).

Reduction in livestock

Table 7.10 shows that livestock production is reduced by the impact of changing climate. As many as 84% of respondents indicated that due to drought and shortage of water they are faced with reduced livestock. This has affected the production of meat and dairy products. They stated that due to this reduction they are forced to buy meat and milk from the shops, which is more expensive.

It also appeared in the discussion of the focus group that due to droughts and shortage of water, livestock farmers are working at a loss, as most of their animals find it hard to survive, especially in the dry season. This then means that their meat and milk production is reduced. Respondents indicated that even when they try to reduce their numbers, they still face the challenge of low quality, which makes it difficult for them to penetrate the market. Supporting evidence states that due to droughts and low rainfall patterns, livestock will be more vulnerable and reduced meat production means that the poor will not have access to meat (Bourne, 2012).

Reduction in crop yield

The literature shows that crops are more vulnerable to climate components such as precipitation, temperature and extreme events. As reflected in Table 7.10, 68% of respondents supported Parry et al,

(2011), when they indicated that climate change impacts negatively on their crop farming, which is their main source of food security. In the focus group a consensus was reached that the soil is also no longer rich and had reduced its fertility due to the continuous drought and high temperatures. They responded that during the dry, hot seasons, lack of rainfall kill their crops because they depend on rain-fed farming.

Increase in prices farming commodities

All respondents indicated that due to the climate change, the agricultural commodities, such as feed, fertilizers, pesticides etc., have all increased in prices. This situation has seen some of their quitting farming because they could not afford. Predictions by FAO, (2012), indicated that due to unfavourable weather patterns more farmers will lose their agricultural income and more may prefer to quit farming. It is evident that to some, farming has become unaffordable due to increasing prices coupled with their low income.

Increasing incidents of diseases

In Table 7.10, 76% of respondents mentioned that due to high temperatures, there is high spread of diseases. This puts both human and animals on stage. People living in rural areas are more vulnerable due to their socio-economic status. They struggle to get access to basic medical health. This situation was confirmed by Pienaar and Van Fintel, (2013); when they stated that rural communities are susceptible to illness, heat stress, food insecurity and malnutrition, all of which are projected as health hazards.

The rural livelihood is really at stake as most people live in poverty and cannot afford good nutritious food; malnutrition is becoming common in the rural areas. Respondents highlighted that due to shortage of food and water in rural areas, more people are attacked by nutrition illnesses such as cholera, HIV/AIDS and malnutrition. They indicated that more animal and crop diseases have mushroomed due to high temperatures, and this puts human health at risk as it compromises the quality of meat and crops.

Shortage of food

According to IPCC (2014), rural communities that depend on agriculture for food are more vulnerable to climate change. The rising temperatures, shortage of rainfall and water scarcity frustrates agriculture. This is confirmed by the results in Table 6.11 where 80% of respondents indicated there is a serious decline in the availability of food due to low food production. These results confirm the research by Rahim (2011), that climate change will affect the dimensions of food security, namely (a) food availability, (b) food accessibility, (c) food utilization and (d) food stability.

7.4.4 Impact of Climate Change on Small-scale farmers’ Food Security

Table 7.11 Impact of climate change on small-scale farmers’ food security

VARIABLES	FARMERS	PERCENTAGE
Shortage of food		
Yes	20	80%
No	5	20%
Increase in food prices		
Yes	25	100%
No	0	
Low income		
Yes	23	92%
No	2	8%
Unemployment		
Yes	22	88%
No	3	12%
Lack of local markets		
Yes	21	84%
No	4	16%

Source: S.M Pheto (2017).

Increase in food prices

The results in Table 7.11 show that due to the changing climate there has been decline in production of food. Extreme weather events have left the soil unfertile and yield on crops has declined. All respondents indicated that increase in price especially on staple food is the cause for food insecurity in rural areas, as more people are unable to afford to buy food. This was predicted by FAO (2011), which reported that since farmers cannot afford irrigation systems they are at high risk as their staple maize crop production has dropped. This situation has then made more people vulnerable to high price of food, which is a serious threat to food security. According to the respondents, only people who have income will eventually have access to food.

Low income

It has been proven from the above Table 7.11 that lack of purchasing power has become a cause for food insecurity in rural communities. Most farmers rely on farming for livelihood, so it becomes difficult when

they cannot produce enough and have to buy food due to low income to those who have off-farm jobs. About 92% of respondents indicated that families where no one has an income are more vulnerable to food insecurity than those who do not.

They confirmed the statement of Manyamba (2012), that food insecurity is measured by a household's inability to provide physically and economically sufficient, safe and nutritious food that fulfils the dietary needs preferred by the households.

Unemployment

Table 7.11 shows negative response in employment of respondents. As 88% of them are unemployed and they live in poverty. This reduces their ability to have productive assets and improve on their production of food. FAO (2015) explains that because of the unreliable weather patterns, in rural areas food insecurity will be influenced by factors such as poverty, unemployment, lack of education and underdevelopment.

Table 7.11 has also confirmed these predictions. Majority of respondents indicated that there is a need to have extra income through employment, so that they sustain their access to food even during bad weather conditions. The focus group also agreed that when people have employment they are able to buy from local producers and in that way production is increased due to the demand.

Lack of local market

Table 7.11 shows that there is lack of local market. This, according to 84% of respondents, is due to lack of buying power from the locals. Some argue that this kills local market, as producers are also unable to improve on their production when they do not have enough income. This proves the claim made by Langba (2014), that rural areas are already forced either to reduce their livestock or part with some of their entitlements to sustain their local markets.

During climate-triggered food crisis, they are forced to sell their produce at a loss in order to sell them fresh; otherwise they lose their quality. The focus group also indicated that when food price goes up in the market, in most cases it is due to commercial farmers who monopolises the markets. They also indicated that they are always not meeting the required standards in terms of quality and quantity due to their low capacity to adapt to climate change.

7.5 HOW SMALL-SCALE FARMERS COPE WITH FOOD SECURITY IN THE MIDST OF CLIMATE CHANGE

The previous discussions have shown that even though small-scale farmers are vulnerable to the impact of climate change, they have always had their coping mechanisms to adapt. Research has shown that even in

the face of changing climate with extreme weather events, small-scale farmers are still standing and their traditional coping strategies have sustained them (IPCC, 2014; NWPG, 2015).

Table 7.12 shows the mechanisms that are mostly used by majority of respondents during interviews. In it there are those who indicated that not every farmer could afford to have a borehole in the yard though they would prefer to have them as others have because they reduce stress on water availability.

Table 7.12 Coping Mechanisms

Small-scale farmers have been coping with impacts of climate change	
1.	Drilling boreholes and store water in tanks
2.	Use of drip irrigation
3.	Produced their own compost manure as fertilizer
4.	Crop diversity
5.	Engaged in mixed farming
6.	Adjustment of farming operations
7.	Increased the use of shades for crops and improved shelter for livestock
8.	Plant trees around the garden
9.	Opt for off-farm jobs to augment income
10.	Plant early or late depending on weather pattern in a season.

Source: S.M Pheto (2017).

Research has also confirmed that in areas where farmers are unable to afford irrigation system, they need to invest in harvesting water during rainy season so that they can last them for the drier seasons; this has been found to be working for in developing countries (Botzold; 2015, Kusanganya, 2012).

Respondents indicated that to improve the quality of soil after an extreme weather they produce their own organic fertilizers. Research has also indicated that it is important to improve the quality of soil with fertilizers after natural disasters, particularly floods and droughts (Nhemachema et al., 2010).

In the group discussion it was agreed that majority of farmers diversify their farming to curb the negative impact of climate change. They indicated that in most households, there are indigenous chickens roaming the garden, there is also a small garden for crops and less than twenty livestock. This is to sustain their food security. This has been found to be in line with Mandleni’s (2011) view that for small-scale farmers to avoid being pushed out of farming, they need to diversify their produce in order to survive.

Majority of respondents indicated that the use of drought resistant crops such as traditional crops could be done to ensure that people do not end up in famine. They indicated that there are indigenous crops such as sorghum that are drought resistant and provide staple food to the majority of rural communities. This confirms the study of Van der Hoeven (2013) when she expressed the view that in the midst of the changing climate, rural communities in the North West could invest in their indigenous crops such as rape (*rapa*), brassica carinata (*sepaile*), to ensure food accessibility.

The focus group confirmed that most of the indigenous crops are easy to store when they are out of season. They are processed and dried for use later when production is not good. Indigenous free-range chicken and nguni cattle are also drought resistant animals that can be helpful to small-scale farmers.

Fig. 7.5 To protect crops from hot and cold weather conditions farmers use shades or nets



Source: S.M Pheto (2017).

As indicated in Table 7.12, majority of respondents mentioned that when the weather is not favourable they delay planting to avoid loss. They adjust their farming and timing depending on the climatic patterns. The focus group also agreed that farmers build trees around their garden and improve shelter for their livestock so that they are not frustrated by extreme weather events. They also confirmed what was suggested by Delgado, (2010) that small-scale farmers should consider having off-farm jobs to augment their income and improve their production.

7.6 BARRIERS TO EFFECTIVE ADAPTATIONS

Small-scale farmers have their share of frustrations in trying to adapt to the effects of climate change. Even the research attests that even when they try so hard to keep afloat, their inability to afford effective adaptation methods become threats to their production (DAFF, 2014).

Table 7.13 Barriers to adaptation

Identified barriers to adaptation
1. Lack of water and Irrigation System 2. Lack of financial resources 3. Lack of equipment and production inputs 4. Shortage of skilled Extension Officers

Source: S.M Pheto (2017).

7.6.1 Lack of water and Irrigation System

As indicated in previous chapters, the shortage of water in most areas in the North West is a serious barrier to food production. Majority of respondent indicated that water determines what they produce and how much they produce. Without proper water resources they are unable to up their game.

This is a clear confirmation of what research has shown that most farmers depend on rain fed agriculture to produce food but without water food production is doomed (FAO, 2014; Adger et al., 2009).

7.6.2 Lack of financial resources

Unfavourable socio-economic status of small-scale farmers cannot be overemphasised. Research has shown that small-scale farmers are very vulnerable to a range of issues due to their rural character. There is enough evidence to confirm the respondents’ claim that nobody wants to give them financial assistance that they need due to their inability to prove that they are not financial risks.

This status then implies that without financial assistance they will not meet their financial farming needs (Adger et al., 2009). Majority of farmers indicated that in the dry season their land needs mechanisation to plough and irrigation systems to keep up, but they cannot afford them and would like assistance.

Studies confirm that without financial independence, small-scale farmers will find it difficult to cope with the effects of the changing climate (DAFF, 2014).

7.6.3 Lack of equipment and production inputs

According to Madzamuse (2010), rural communities need to be assisted by government and other institutions in order to effectively adapt, however, he attributed lack of that to skewed distribution of resources by government which makes it difficult for small-scale farmers to benefit from such programmes of government.

Majority of respondents indicated that lack of proper equipment and appropriate production inputs are barriers to their efforts to adapt to changing climate. Research has proved that farmers with adequate production inputs, appropriate equipment and land available have all it takes for good production (Nelson et al., 2010).

7.6.4 Shortage of skilled Extension Officers

Although government has met farmers halfway by appointing extension officers in various aspects, small-scale farmers are of a different view. Majority of respondents indicated that shortage of skilled extension officers needs to be priority for government if it really wants to uplift small-scale farmers. They indicated that the number of extension officers is a drop in an ocean to the numbers of in the Province.

In the focus group it was evident from the discussion that the Extension officers did not have much on climate change therefore could not answer most of participants' questions specifically on the changing climate. It was evidence enough to conclude that Extension Officers need to be capacitated in order to be effective messengers of government to farmers.

One question that the study wants answered is which effective adaptation strategies could be adopted by small-scale farmers in the North West Province. From the above section, it is evident that small scales farmers have made efforts to adapt in the way they could afford, however after discussions and consultations with research and other knowledgeable people, there are effective recommended adaptation strategies that could assist small-scale farmers to adapt.

7.7 EFFECTIVE ADAPTATION STRATEGIES FOR SMALL-SCALE FARMERS

Table 7.14 Adaptation Strategies

NORTH WEST ADAPTATION STRATEGIES	
EFFECTIVE ADAPTATION STRATEGY	POSSIBLE ASSISTANCE AGENTS
1. Crop diversification	Government to provide training support through extension services
2. Integration of modern and indigenous Farming practices	Government to integrate modern and indigenous practices in planning and policy
3. Improve water management practices	Government and traditional authorities to avail land to increase dams and support farmers with boreholes.
4. Adjustment to farming practices	Training should be provided through extension services
5. Switch to more climate tolerant crops and breeds	Training should be provided through extension services
6. Produce own fodder, and manure for fertilizers	Training by extension services and other commercial farmer mentors
7. Adjust planting periods according to climate	Information be provided by extension services
8. Adaptation of mixed farming	Training be provided by extension services
9. Improvement of livestock shelter and crop field	Small-scale farmers with the assistance of extension services
10. Livelihood diversification	Government to create jobs in rural areas to enable small-scale farmers to diversify their livelihood
11. Provision of new technology, equipment and farming inputs	Assistance of government will be needed.

Officials of government confirmed the body of knowledge and identified the following effective adaptation strategies that have proved to be working for small-scale farmers. However it is also important to note that small-scale farmers may not be able to implement the above strategies on their own, they would need the assistance of government and other role players to effectively adapt.

As indicated in Table 7.14 Government officials identified the following adaptation strategies that could be effective in assisting small-scale farmers in the North West Province to adapt to the impact of climate change; (a) Crop diversification, (b) Integration of modern and indigenous farming practice, (c)

Improvement of water management practices, (d) Adjustment to farming practices, (e) Switching to climate tolerant crops and breeds, (f) Production of own fodder and organic fertilizers, (g) adjustment to planting periods, (h) Adaptation to mixed farming, (i) Improvement of livestock shelter and crop gardens, (j) Livelihood diversification (NWPG, 2014; NW READ, 2013).

7.8. ROLE OF GOVERNMENT IN ADDRESSING RISKS AND CHALLENGES OF CLIMATE CHANGE

Government is mandated by the constitution of the Republic of South Africa to take care of its citizens, rich and poor, young and old. It is government’s role to ensure that agriculture that is the source of food is doing well in urban and rural areas alike.

Table 7.15 Role of government in addressing risks and challenges of climate change

ROLE OF GOVERNMENT IN ADDRESSING RISKS AND CHALLENGES OF CLIMATE CHANGE
1. Financial support to farmers
2. Water management
3. Increase restrictions on water usage
4. Provision of farmer support programs
5. Capacity building on increasing farming production
6. Provision of accurate weather forecasts
7. Conduct research on soil samples for accurate planting of crops
8. Capacity building to manage risks on natural disasters
9. Development of policy to ensure mainstreaming of climate change in all its programmes and projects to encourage adaptation
10. Increase awareness campaigns to citizen on climate change

Source: S.M Pheto (2017).

Respondents indicated that since most small-scale farmers are resource stricken, government needs to provide financial assistance to farmers to effectively adapt. They indicated that most areas in the North West struggle with water. This confirms the report by DWS (2015) that shows that there is dire need to

save water, as there is shortage of surface and underground water. The respondents suggest that government should enforce some restrictions on water usage to ensure that people adapt.

Respondents acknowledged assistance that government is giving to small-scale farmers through farmer support programmes but they equally raise concerns that very little number of small-scale farmers benefits from this programme.

According to respondents, capacity building is provided to farmers through Extension Officers who, according to them, are responsible for (a) providing technical advice to farmers, (b) providing seeds, fertilizers, pesticides, skills and training to farmers, (c) coordinating funding and harvesting assistance to farmers, (d) Coordinating markets and joint ventures or partnerships with commercial farmers, and (e) providing climate advisory information. This response confirms Mashamba’s (2012) claims that extension services need to be in every village and government centre to enable farmers easy access to assistance. The finding then suggests that skilled extension officers are vital to assist small-scale farmers to understand the impact of climate change and its risks.

Fig 7.6.The household packages that were given to small-scale farmers to promote one family one-food garden.



Source: S.M Pheto (2017).

Findings from the respondents are that government needs to take climate change adaptation very serious like it did with all other threats such as HIV/AIDS, Shortage of electricity and domestic violence

programmes. Climate change should be mainstreamed in government policies and programmes so that people are motivated to adapt. Awareness campaigns should also be conducted in rural areas where people do not have pleasure of access to information on climate change and its impact. CARE International (2011) suggests that knowledge management and information sharing across sectors, communication and awareness campaigns assist in the dissemination of information.

7.9 NORTH WEST GOVERNMENT PROGRAMMES AIMED AT ASSISTING SMALL-SCALE FARMERS

Table 7.16 North West Government programmes aimed at assisting small-scale farmers

PROGRAMME	ROLE PLAYER
Farmer support Programme	NW READ
Mechanisation Programme	NW READ
Farmers’ market	NW READ/UNIWEST
Kgora Farmer Training Centre	NW READ
CRDP Projects	ALL GOVERNMENT DEPARTMENTS
Female Farmer Competition	DAFF, NW READ
Extension Service	NW READ
Nguni Cattle Development Programme	NW READ
Fetsa Tlala	NW READ
CASP	NW READ

The study found that although programmes listed in **Table 7.16** are provided to farmers in the North West, however it was confirmed that more small-scale farmers are not aware of them and some who are aware have not benefited from them. The respondents indicated that government needs to strengthen its medium of communication with in rural areas in order for them to know about the programmes.

Rural areas miss more important information as they live in areas where development is very slow and people delay to get information. Majority of respondents confirmed that they are aware of some of government programmes aimed at assisting; however, the beneficiary selection is always skewed and leaves most deserving poor farmers without benefits.

In the focus group it was echoed that programmes such as Fetsa Tlala, which is aimed at promoting food security in rural areas is a good programme, but it is just a drop in an ocean, considering the number of people in the Province. Some indicated that the terms and conditions to government programmes are always not favourable to them. For instance, for a small-scale farmer to qualify for Nguni Cattle Project, one needs to have specific size of land, and infrastructure to qualify. Most people in rural areas do not own land and any modern infrastructure but normal kraal for livestock.

Most respondents indicated that they are aware of programmes such as Letsema and Comprehensive Rural Development Programme (CRDP) but the application to government programmes takes a long time and only few farmers are catered for. They indicate that although government is trying to assist them, the arrangement of shared mechanisation or form cooperatives in order to access assistance has not worked for them as other people do not cooperate and others are not committed to farming. That is why most cooperatives fail.

7.10 THE STATUS OF FOOD INSECURITY IN THE NORTH WEST PROVINCE

Figure 7.7 Determinants of food security in the North West

Source: S.M Pheto (2017).



Identified determinants of food security in the North West are summarised from previous sections. Age, gender and educational levels were used to characterise the respondents.

Due to the changing weather patterns in the Province food production has gone down. Although considered to be more vulnerable to the changes in the climate, small-scale farmers just can't quit because they consider agriculture as a source of their livelihood and income. Although the majority of respondent indicated that they never reach a point where there is absolutely nothing to eat, they however

acknowledged that there are times when they have to borrow from neighbours or sell some livestock in order to ensure that there is food on the table.

The definition of food security demands that food should be available physically at all times, but that is not the case in small-farming communities. When the yield is good, most respondents indicated that they have enough and sell the surplus at the local market and to neighbours. This gives them an opportunity to save money, or improve their production by buying more seeds, fertilizers and equipment. The opposite means that they have to buy food from the markets, which is always a very unsustainable move as the money, do run out.

Although the respondents mentioned that due to shortage of rain and droughts the production of food has decreased, they acknowledge as well that food availability is not achieved as there is not adequate food readily available (FAO, 2015).

Respondents indicated that although they produce less due to the changing climate, they couldn't guarantee their access to food. They mentioned that when the yield goes down, they are forced to buy food from the markets, and when they buy food they are always limited in terms of preferences and nutritious requirements due to increase in price of food, so they end up not affording the preferred food especially those that give them a balanced diet. When they do not produce more they fail to sell and cannot make profits.

Their common strategy is to either reduce their quantity or resort to eating only twice a day. Some indicated that accessing food was difficult as it was not even stable, sometimes they access, the other times they afford to procure food. The only suggested solution by FAO (2015); Delgado et al., (2010) and Bals et al., (2008) is to diversify their livelihood, those who can afford to look for jobs can do so to augment food that they produce, so that they can afford access to food.

Respondents mentioned that even when they access inadequate food and purchase them, they are limited in terms of choice. People staying in urban areas have more access to available varieties of food. They even have a choice on the prices, but most respondents indicated that even if they have food available, they only buy what they can afford not what they want, usually without consideration of whether food is healthy or not. Due to the poverty levels in rural areas, lack of access to adequate nutritious diet is very common; this is why most people are malnourished by not eating healthy diet.

Based on the above information coupled with the definition of food insecurity, what is deduced is that in rural areas, small-scale farmers are still food insecure if they have issues with access to food either through purchase or producing, inappropriate distribution and inadequate utilization (Stats SA, 2016; FAO, 2015).

7.11 SUMMARY

According to the study undertaken by this researcher in the North West Province, it is found that the Province has characteristics of rural Provinces and the impact of climate change in the Province, though not unique to other Provinces, is complicated by the incapacity of the small-scale farmers to adapt.

This chapter outlines the profile of North West province focusing on agriculture, water, human settlement, electricity and economy. These are factors that determine food security in particular in rural communities. Majority of people in rural areas rely on agriculture for the production food; agriculture needs water availability in order to produce yield; people need to have proper shelter with resources such as electricity to prepare their food and they need to have access to income in order to afford to buy electricity or to buy food. These factors are important for the study as they are related in their link to food security.

The chapter determines how people in the North West Province access food and impact of climate that affects them in their food production. The impact on their livelihood identifies the challenges that they have in their accessing food such as shortage of water, low income, unemployment, poverty and shortage of land.

This chapter describes the impact of climate change on agriculture in the province. The majority of rural communities rely on agriculture for food production however, the effects of climate change such as rising temperatures, unreliable rainfall patterns and extreme weather events reduces livestock production and crop yield, which are the main sources of food in rural areas. This also has a great influence in the increase of agricultural commodities that serve as barriers to their affordability to continue farming. It has been found out in the study that the changes in climatic conditions do not only affect humans but also have the potential to increase diseases for plants and animals and negatively impacts on availability of food.

In this chapter the impact of climate change on food security in the North West has been discussed. A decline in the production of food due to climate change, leads generally to a shortage in locally produced food. This becomes a challenge for impoverished populations that rely on their own food production and cannot afford to buy food. Another dimension is that those who are in farming do not produce much therefore they are left with no surplus to take to the market, and because there is shortage of food even in the market they are forced to buy food that they do not really prefer but that they can afford, which makes them vulnerable to buying food that is cheap and not healthy.

Although farmers in the province have their coping strategies, on the negative note, they also have barriers to their adaptation that pull them down. Shortage of water and lack of access to water supply frustrate most determined farmers, in particular, small scale farmers who can not afford irrigation systems

for dry season. Majority of small-scale farmers need financial assistance in order to apply effective adaptation strategies, but unfortunately, due to their financial status, they do not even qualify for loans at financial institutions.

This chapter discusses the discovery that lack of equipment and production inputs have been barriers to adaptation by some farmers, this coupled with lack of effective extension services indicate that small scale farmers need capacity and knowledge on climate change impacts and how to read climate change forecast information as presented in radio, magazines and books. Lack of education is still key area of their inability to comprehend this information.

Effective adaptation strategies are determined and discussed in this chapter. While it is crucial for farmers to improve their food production, it is equally important to adjust their farming practices and planting seasons to adapt to the effects of climate change. Diversification of livestock breed and drought tolerant crops is crucial as adaptive strategies. To improve yield and productivity, integration of modern and indigenous farming practices, use of new technology and farming inputs is very beneficial as an effort to manage the impacts of climate change.

Government has a huge role to play to ensure food security in this Province, and so the role of government is discussed in this chapter, outlining the support that is needed and provided to farmers such as financial resources, capacity building and farmer support programmes that ensure sustainable food production.

While it is important to effectively use scarce water effectively, government has the responsibility to ensure that the available resources are shared appropriately among sectors so that some sectors should not thrive at the expense of other poorer sectors. The low levels of education of most farmers cannot be overemphasised, therefore it is crucial for government to invest in capacity building for farmers to manage natural disasters and enhance their skills to interpret weather forecast information. They also need expert assistance of research on their specific type of soil in order to plant accurate crops to improve their yield.

It is however encouraging to learn in this chapter that government has also made an effort to assist the small scale farmers with programmes that enable them to be sustainable in the era of climate change. However, there is an acknowledgement on the side of government that the programmes may not have reached all small-scale farmers but they have already started to implement most of them.

This chapter also outline programmes that are implemented by government of the North West in order to curb food insecurity. Farmers have farmer's markets where they are given an opportunity to sell their local produce. There is also Kgora Farmer Training and Development Centre where small-scale farmers are capacitated on a range of farming issues. Nguni cattle development programme is a project that loans

indigenous Nguni cattle in order to diversity livestock. Mechanization is where farmers are supported with mechanization that enables them to improve and increase their production.

CHAPTER EIGHT

FINDINGS AND DISCUSSION

8.1 INTRODUCTION

This chapter presents the findings obtained in the study in line with the objectives of the study which were; (a) to assess the impact of climate change on food security in Limpopo and North West Provinces (b) to determine how small-scale farmers adapt to climate change, (c) to identify sustainable and cost effective adaptation strategies to cope with the impact of climate change, (d) to determine the role of government in addressing the risks and challenges relating to climate change and food security. The biographic characteristics of the two provinces are presented and compared in this chapter.

8.2 BIOGRAPHIC CHARACTERISTICS OF NORTH WEST AND LIMPOPO PROVINCES

The study observes the biographic characteristics of both North West and Limpopo provinces in terms of their sizes, population, and rural nature. Limpopo is 127 755km square and bigger than North West with about 19 243km square. North West is about 106 512 km square. Even in population Limpopo has a population of about 5.4 million while North West has a population of 3.5 only.

Although the two provinces are not of the same size, they are both rural provinces. They have a similar history of being formed out of the home states. Limpopo was Lebowa kgomo and North West was Bophuthatswana. It is important to mention that one of the findings of the study is that most of South Africa's former homesteads have the same characteristics of slow development, high poverty levels and high unemployment rate, which is the case with the two provinces in question.

The study also discovered that both provinces are rich in minerals and have mining as one of their major participants in economic development, but it also appears that despite making profits, mining companies do not invest in the communities that they operate in and, in most cases there are disputes about ownership of land and distribution of wealth around the profits. In essence the communities do not benefit, which is why the economy around the mining areas is overshadowed by increase in population even though there is limited employment and resources to sustain the influx into these areas.

It has been found through StatsSA (2015), that these provinces are ranked among provinces where development and service delivery are slow. The study has also uncovered that due to the perception that the provinces are rich in minerals and have mining areas, many people migrate to areas like Rustenburg in the North West, with the hope of finding job at the mines, the finding through NWPG (2016), shows that mining profits have also declined and mining companies are retrenching more than hiring new labourers, so the areas end up with more unemployed migrants causing more stress on the available resources such as water, food and shelter. From these findings, it is then clear that the beneficiaries of the mining profits in

these areas are not the local people, it therefore shows that there needs to be legally binding understanding of the mining companies with the local authority to put strict social responsibility policies that will ensure that the locals benefit equally from the profits from mining industry.

In trying to cater for the influx in towns, the rural communities suffer service delivery and other developmental needs. One such need is the issue of housing and, since government started with the Reconstruction and Development Programme (RDP) to accommodate the disadvantaged groups in neighbouring town areas with free houses, so that they can live next to their place of work, the programme has not been able to reach the rural areas, because people keep on occupying land illegally creating squatter camps and demanding houses in unplanned and service areas.

The study found out that even though Limpopo province is a rural province like North West province, it is bigger in size and in population, and shares more borders with other country, making it more vulnerable to the influx of immigrants from these countries. With its limited resources, Limpopo battles with growing population that does not correspond with economic growth but instead leads it further in to deeper poverty as stated by Stats SA (2011).

Majority of the people in Limpopo's rural areas are not educated therefore the types of jobs they do are not paying much to enable them to afford reasonable standard of living. Although North West is also rural, it is clear from the study that it is better off on issues of poverty than Limpopo, Majority of the people are employed in the public service and therefore are more stable than those outside the public service. Both provinces serve one government therefore the social challenges such as shortage of housing, lack of service delivery in most rural areas, lack of good governance at provincial and municipal level affect the development of rural areas in both provinces. Even though both provinces are blessed with minerals that were supposed to boost their economies, it has been clear in this study that the profits that come from the mining industry have not been benefiting the communities. However, the main finding is that small scale farmers in these Provinces are vulnerable to the effects of climate change and need assistance to adapt in order to continue producing food for sustainable food security.

8.3 DEMOGRAPHICS

The study focused on small scale farmers as producers of food in rural areas. It has been found that both provinces have commercial and small scale farmers who are divided by their socio-economical status, making commercial farmers more advanced as they farm for profits and are less vulnerable to the effects of climate change because they can afford to adapt. On the other hand there are small scale farmers who are farming for subsistence and very vulnerable to the impact of climate change and have less or no resources to adapt to the effects of climate change to a point where some are pushed out of farming by poverty and inability to sustain their food production.

Although the study purposively targeted small scale farmers in rural areas, it also considered women as the main participants in small scale farming. This was supported by Altman et al., (2009) stating that women make up to 61% of those involved in farming but who are not considered in the success stories of farming. In both provinces more women mentioned that they participate to generate more money and food for their families.

It has also been found that in both provinces due to greater participation of women in agriculture, the Department of Agriculture, Fisheries and Forestry (DAFF) has established a competition for women in agriculture where, on annual basis, rural women who performed well in different categories of farming (subsistence, national producer, exporter etc.) are acknowledged through national awards, to assist women who are showing more commitment and effort in curbing food insecurity in the provinces. This study discovered that both provinces have been participants since its inception in 2009 (DAFF, 2016).

Gender statistics in this study found 14 respondents to be male and 31 female. This was the representation of respondents that were successfully approached and who agreed to take part in the study. Their age distribution found the majority of respondents being over 40 years, between 45 to 55 to be precise, while the remainder was shared by those younger than 40 years and those older than 55 years. This could be a representation of people who are old enough to make commitment of making it in agriculture, while they are still physically fit. Those younger may look at available options when farming is not making enough money for then and consider off farm employment. It is clear that although women has the same morale obligation to participate in farming, they always ensure that they take a leading role even when the spouses leave home to look for job elsewhere. This is a clear indication that more support needs to be provided to women to increase agricultural labour market.

The study found that the respondents from Limpopo were less educated than the ones from North West Province. This could be attributed to the provincial statistics of educational levels where North West still has the higher level of educated people even in rural areas. Another factor as discovered in the study is the fact that those from Limpopo were full-time farmers from the time when farming was still rural norm, while the educated farmers take farming as a source of extra income (Aliber, 2009).

From both provinces the majority of respondents indicated that they practise their farming at their backyard or family farm. This is the implication that supports shortage of land in rural areas, where people do not own land and do not have access to land more than a few hectares for garden. This disadvantages farmers who want to grow their farming to commercial stage because they do not meet the market demand by producing in a backyard and even the income they make is very small to afford them any opportunity to expand their farming (Baiphethi, 2009). This is coined with the sources of income in these provinces, which implicates that farming in rural areas is a source of income for majority of

households. From this finding it is clear that both provinces need to create policies that promote viable and dynamic rural labour market that will sustain job creation in rural areas.

The study tested the availability of food as a dimension of food security. It is evident that although many people have run out of food in their households, in both provinces, few people have gone hungry without food at all in their households. Of importance is the notion based on the definition of food security, that majority of people in both provinces fail to meet food security, all the respondents in both provinces indicated that they have reduced their meals to save for the next meal, which shows that there is a challenge in food accessibility.

Again there is the issue of balanced diet and all respondents indicated that they have not had balanced diet, and they have had to skip meals sometimes. This again is against the food stability dimension of food security. It is a clear indication that respondents were not able to access food of their dietary preference at all times to meet their health needs; therefore they are not food secured. This study discovered the relationship between household income and food security status. The relation between education and food security is also found to be consistent and this supporting the expected link of household socio economy and food security. In both provinces, there is the tendency of high levels of food insecurity, which supports the fact that the results are not negatively exaggerated but shows that food insecurity is a reality and in the midst of climate change it remains a threat to life.

The finding on food production supports Sen's entitlement theory that even those small-scale farmers, who produce food, had their episodes of food insecurity. The study has also proven that household food production does not necessarily mean household higher food security status, but households should have other sources to complement their food production. The reality to support this is that even households that lack external income are not able to compensate their food security status by producing food for subsistence purposes.

On the question of whether respondents were aware of climate change and what was their perception on the changing climate, all respondents showed that they were aware that climate was changing, as they realised changes in temperature and lack of rainfall causing occasional droughts. They also realised that there is generally shortage of food in local markets, causing them to buy food with increased prices. The findings here indicate that all farmers are aware of change in climatic conditions and how they understood climate change against its definition.

Even though they did not understand what causes climate change, their experiences and observations were correct about the effects of the changing climate in the last twenty years. They observed that there has been a decline in rainfall patterns, and there have been high temperatures that created heat waves

which never really took place in the last 20 years. Accordingly these observations were correct in terms of the projection of climate change in both provinces.

8.4 IMPACT OF CLIMATE CHANGE ON LIVELIHOOD

Climate change has impacted negatively on the availability of water in both provinces, however, in Limpopo, 80% of respondents indicated that there is shortage of water in their area, which affects their agricultural activities. In the North West, all respondents indicated that they have shortage of water in their areas, they even went further to explain how they have gone for days without water, and on many occasions they are forced to share drinking water with animals due to shortage of water. Majority of respondents from Limpopo indicated that they depend on food they produce and income from the surplus they make however, low production due to climate change means they are not able to have enough income to supplement the available food. This was also echoed by respondents from North West who indicated that they use the money they make out of farming for other household needs so with reduced production their income is also reduced. The finding here is that although water is a national challenge, more investments in conservation and water management is necessary to assist small-scale farmers to sustain their productivity for food security.

The majority of respondents in both provinces admitted that climate change and its impact have led to poverty, as they often do not recover from severe heat and high temperature episodes. *“sometimes even when it rains, we are sceptical to invest on farming, as it often happens that the season just changes before our crops finish their circle and we lose our crops to drought. We do not want to rely on relief food from government but we want to grow our own, but we also need help from government so that we can sustain our adaptation strategies”*. These were the words of one farmer who felt helpless when he lost his livestock to drought and high temperatures. It is comforting to see how dedicated the small-scale farmers are to food production, this calls for prioritisation of relief strategies for small-scale farmers.

All respondents from both provinces highlighted the importance of land for farmers in order to maximise their production. This is in conformity with Deressa et al (2010) who stated that there is no sustainable farming without land that can be used to feed a nation.

“in the olden days every village used to have communal dams where water were reserved for animals during dry season, today we see houses mushrooming everywhere without proper planning, and consideration for grazing land. We would really appreciate it if small scale farmers could be allocated grazing land where they could even build dams to harvest water for their livestock”. one farmer lamented.

Respondents indicated that due to shortage of farming land they are not able to be creative in diversifying or practising mixed farming to improve their production, and insists that such practices would assist them to sustain their farming activities. This study found out it is necessary for land restitution and distribution

programme of government to be strengthened, as this would assist farmers to increase their agricultural production in order to improve their livelihoods, income and reduce vulnerability in their neighbourhoods. It is therefore clear that issue of land redistribution should be prioritised by government to assist small-scale farmers who want to contribute to the economy through agriculture, they also needs to be supported through financial resourcing to ensure sustainability of their food production.

8.5 IMPACT OF CLIMATE CHANGE ON AGRICULTURE

South africa's agriculture depends on rainfed water, so without good rain agricultural production suffers. All the respondents indicated that crop yield is suffering the direct impact of climate change and reduction in crop production is evident even at the market. This, for all respondents means that their food stock is gradually deminishing due to direct impact of changing climate. Some respondents from Limpopo indicated that although it is risky, they have started to do their planting in winter due to the fact that lately, short winter days seem to be cooler and more favourable to crops in retaining water brought by winter rains. The finding confirms the predictions that climate change is likely to affect the production of crops through its reduced and unpredictable rainfall and high temperatures (IPPC, 2011; Nelson et al., 2010; Neves and Du Toit, 2013).



Generally, in both provinces due to high temperatures, there seem to be reduction in livestock farming. Respondents attributed this to the sensetivity of livestock in particular heat periods. They indicated that livestock is very vulnerable to diseases and reproduction challenges due to heat stress. This is in conformity with Bourne, (2012) and Thornton et al., (2009) that inconsistant temperature variations and episodes of severe droughts due to climate change reduce reproduction among livestock and eventually affect livestock production.

It is also discovered in this study that due to the demand of food and competition to improve and sustain food production, the cost of farming commodities have gone high, which disadvantages even small-scale farmers who wants to improve their farming to miximise their production. One elderly woman stressed in her own words how difficult it has become for small-scale farmers with the rising prices of agricultural commodities.

“Unfortunately for us small-scale farmers poverty has already fallen on us, due to reccurent droughts, we no longer afford anything in the market, everything has become so expensive that we cannot even afford to buy implements to improve our farming or change strategies enable us to adopt, we are just farmers without production.”

Van Schalkwyk (2012) indicated that there is a huge impact of climate change on agricultural economy, demanding a huge adjustment on agricultural commodities and food price hikes. It has also been confirmed by respondents that improving their farming has been made more difficult by rising prices in

agricultural inputs, fertilizers, tools and even small accessories making it even more difficult to afford farming itself.

Another discovery from this study is that although climate change has contributed to farmers' production decline, it has also destroyed some passionate and committed farmers' livelihoods, as many of them are not educated, and their chances of livelihood change options are limited and could not afford adapting to climate change impact. The finding has confirmed that notion by Aliber and Hall (2010) that low poverty level, education and income are determinants of successful agriculture. It was found that those who relied on agriculture as their main source of food find it more difficult to access food during droughts and floods than those who use agriculture as an extra source of income or a hobby. *One young farmer suggested that private and public sectors can invest on youth through training and development. "If youth in rural areas could be capacitated and be assisted with development of small scale irrigation schemes and hydroponics, we could improve agricultural production in our areas."*

These findings are a clear indication that small scale farmers need to be assisted to adapt to climate change, otherwise the reduction of food production means the reduction of food security that will eventually lead to hunger, famine and death.

8.6 IMPACT OF CLIMATE CHANGE ON FOOD SECURITY.

Food availability is enhanced by food production which in turn influences accessibility of food. Accessibility of food also depends on the capacity of a household to produce its own food or ability to buy food. Majority of respondents indicated that poor yields affect the availability of food, causing high demand for food, which in turn influences food price increase. In their perspective all respondents view shortage of food as a direct result of increasing food prices due to high demand.

Considering the high prices of food, all respondents indicated that low income and unemployment influence accessibility of food. They further indicated that when they produce their own food and have good yield, they are able to make surplus and take that to the market for extra income, but if they do not have enough yield, their access to food becomes a problem because they are forced to buy.

"generally there is shortage of food, we used to have fruit trees in each household and we would have enough and sell surplus, Rustenburg used to be called a land of citrus fruits. From Rustenburg to Brits, we used to have many citrus fruits orchards, oranges, lemons, nartjies and peaches etc. After some years the trees started to skip some years without bearing fruits until there was really quite a few trees due to lack of rain. We used to sell oranges along the N4 mainroad and many of us went to schools with money made out of citrus sales, today we are forced to buy fruits from supermarkets with a high prices." One participant from the focus group highlighted during the session.

This confirms Blummerl et al., (2010) statement that when there is an extra income involved, even with poor production food accessibility is not much of a problem. This finding indicates that food stability does not depend on the production of food only but also the accessibility of food through other means such as employment to be able to afford to purchase food.

The relationship between poverty and food security in so far as climate change impact is concerned, has been uncovered in this study, when respondents indicates that lack of access to basic services increases the vulnerability to the effects of climate change and eventually lead to food insecurity. Rural communities are underdeveloped and using impoverished sources of water that are unhygienic; they use paraffin, wood, or coal to prepare their food, they are likely to have adequate access to food (Mandleni, 2011). This finding collerates with the entitlement theory and food sovereignty approach in that when people have other sources of income, they have a choice of whether they buy food or cook food depending on their prefence. This is also in relation to the household economic approach which describes that lack of income or low levels of household income puts a household into a vulnerable position including difficulty to access food. An elderly man from Limpopo said,

“due to lack of declining rainfall patterns and high temperatures, we have lost our wealth that was given to us by our creator. Growing up food was never an issue, jobs were never a hassle like today. Our area used to have more Mopane worms (masonja). We never had to go far to harvest Mopane worms to fill up the bucket. Our parents would sell Mopane worms for us to buy cloths and go to school. They were our best way of making quick money hence we did not worry about jobs, we had natural food and there were crops and fruits all over the yards, today we have nothing, our wealth and food are gone.”

It is clear through these findings that climate change has already created a disaster for rural communities. For people who do not afford food sold in markets, who cannot produce their own, even the indigenous food that used to be freely available have been reduced to nothing.

8.7 COPING MECHANISM OF SMALL SCALE FARMERS

With food production deminishing in other households, all respondents indicated that they resort to their own coping mechanisms to sustain food availability in their households. Majority of respondents reduced food intake by skiping meals to save for the next meal, however, Mallikarjuna (2013), raises the fact that skiping meals and reducing food intake may have a negative impact on health, especially members of households who are on medication. This puts on the spotlight the relationship between poor health and shortage and lack of access to food. A participant in the focus group indicated that,

“In our African culture we are know to be caring and sharing people, but because of this severe shortage of food, one finds it difficult to ask for food, especially when you are not even sure, how long that will take. Some kids even leave home to beg for food when they cannot cope with skipping meals at home, this

is very unbearable to us as parents, as it is our responsibility to provide for our kids not strangers, this really rips us of our dignity.”

Other respondents indicated that under extreme conditions they borrow from relatives and neighbours or buy food on credit. Respondents did indicate however that borrowing food or money is a very risky and shameful mechanism; it often causes conflict among friends and relatives when the borrowee fails to bring back the food or money as promised. This is in conformity with sustainable livelihood approach of living, which emphasises people's independence in livelihood resources. When people understand their livelihood better, they tend to cope better, but for those who remain unprepared for life distasters are always very vulnerable to livelihood shocks (Thompson et al., 2010).

A very small percentage of respondents indicated that they resort to selling other household assets such as livestock in order to obtain income to buy food and other farming necessities. These are short term coping mechanisms, which can still lead to hunger if the crisis is not attended to. Otherwise a long term mechanism as indicated by respondents is to look for other means of sustaining and increasing the household income by looking for jobs outside farming or startind a business, which would possibly assist to sustain food availability. The finding is that majority of small-scale farmers do not have back-up insurance and need more assistance from government and the private sector to improve their capacity to adapt.

Based on the findings on the coping mechanisms, it is therefore important to the researcher to recommend long term and short term assistance programmes to small-scale farmers. The short term intervention should deal with the chronic shortage of food which may include not only the social grands but include the social safety nets that would enable small-scale farmers to keep their entitlement of food. The long-term intervention may include government's investment on compulsory education for both youth and adult. Skills training would provide more investment on women and youth. These could also be complemented by micro-financing and job creation opportunities to boost local economy.

8.8 BARRIERS TO EFFECTIVE ADAPTATION

Lack of resources is a major hinderant in small scale farmer's effort to adapt to climate change and its impact. Respondents cited similar barriers to their effective adaptation and they indicated that lack of funding to enable them to use proper farming implements and alternative fertilizers is a challenge. This is supported by IPCC (2014), that adaptation needs funding to take place and in this case these provinces will have to accommodate adaptation strategies in their agricultural activity budgets.

Respondents cited shortage of water as one challenge, more so that irrigation is suggested as an effective adaptation strategy to manage and water conservation. However, some respondents indicated that

irrigation system is also very expensive and they cannot afford it hence they talk of financial assistance to enable them to acquire appropriate equipment and climate tolerant inputs.

There were still some respondents who indicated that if they were given enough information on their specific type of climate change they that were experiencing and how to deal with it by the extension officers of government, they would be able to plan for its in any way affordable to them. The finding here is that there is the willingness amongst small-scale farmers to adapt to climate change and its impact; there is, however, a socio economic challenge that would need government to broaden access to financial assistance for small-scale farmers to enable them to effectively adapt to climate change.

From the findings it is clear that adaptation funding needs to be prioritised as part of agriculture and rural development funding to assist small-scale farmers who are prepared to improve agricultural production despite the changing climate.

8.9 EFFECTIVE ADAPTATION STRATEGIES FOR SMALL-SCALE FARMERS

In this study, studies have identified various adaptation strategies which are directly responding to climate change, and they directly relate to the ones cited by respondents as effective. Respondents indicated that water management and conservation was key to ensure that agricultural production sustains food security. They further suggested that irrigation has the potential to deal with rising temperatures and unreliable rainfall patterns. For some respondents, water harvesting through building of dams and boreholes were other water conservation mechanisms that makes effective use of underground water. Some respondents have practised no tillage method to conserve both quality of water and soil, as it has been found to maintain soil organic matter, and decrease weather related impacts on crop yield. This has also been suggested to be an effective strategy for small scale farmers due to its low costs involved, even though it is labour intensive in removing the weeds (Lal et al., 2009).

Majority of the respondents agreed to adjust their farming practices. They mentioned that they adjusted planting dates and seasons according to the current climate. In some instances they had to delay planting periods to accommodate late rainfall. In some instances they had to integrate their own traditional practices with modern farming practices where they had to apply chemicals to the soil to slow down evaporation during high temperature seasons. some applied manure to keep the moisture content of the soil higher so that it retains soil fertility.

To ensure that they do not lose their animal production, farmers resorted to heat tolerant breeds and produced their own fodder to feed the animals. They also mentioned that during dry seasons they reduced their livestock by selling some in order to keep a reasonable number that would not be too demanding on feed and water.

One participant said, *“it is painful to accumulate wealth in livestock, and ultimately lose it to drought or drought related diseases. Even when we are told to sell our livestock to reduce the number, who do we sell to, nobody has money to buy, even those who buy buy at a very low price because the livestock are also not in good condition. The only people who benefit from this practice are commercial farmers. They drive around our villages looking for livestock to buy at a lesser price, and they have all the resources to maintain them and sell them in good prices.”*

When it is hot livestock farmers build shelter or keep them under trees to provide shade. When it is cold some respondents indicated that they burned firewood to keep the animals warm especially the pregnant and the young ones. To protect their crops majority of the farmers indicated that they use nets or grass to cover and protect plants against heat, cold and frost.

To protect crops and the soil from drought during dry seasons, majority of respondents indicated that they prevent soil erosion by building dams and plant more trees around their yard or farm. Others indicated that they leave the previous harvest residues on the land to prevent soil erosion, in some instances they use mulching to cover the land and protect the soil from erosion.

Since most small-scale farmers cannot afford insurance as they do not have regular income, they have resorted to diversifying their livelihood by engaging in other off-farm activities that would sustain their income. Most respondents indicated that small-scale farmers who engage in farming only are as vulnerable as the people who are not engaged in farming during the extreme weather events because as they lose their production to either drought or floods, they do not have any other alternative source of income, they are forced to borrow or sell some of their entitlements in order to buy food.

From this findings it is evident that due to shortage of resources, financial resources in particular, government needs to enhance its strategies of assisting small-scale farmers, either through loans, grants or insurances in order to give farmers sustainable farming production.

8.10 ROLE OF GOVERNMENT

Government's role in capacitating small-scale farmers is very crucial in adaptation to climate change. Small-scale farmers are characterised by poverty and low levels of income. It is therefore the responsibility of government to ensure that programmes are made to assist farmers in this regard. When asked what type of assistance they would like to receive from government, majority of respondents mentioned that they need financial assistance to enable them to adapt to the effects of climate change.

Some respondents did indicate that even though government has loans that they facilitate with financial institutions such as agricultural banks and commercial banks, small scale farmers are not able to access funding from these institutions because they do not meet the requirements. Most respondents from the

North West also indicated that even though in some instances government drives some initiatives to give them grants and mechanisation, it is always a drop in an ocean, that is done through very suspicious processes.

The respondents also indicated that they would like to be capacitated on climate change and its impact in their specific areas. They mentioned that although government has provided them with extension officers, there is always shortage of manpower and resources for extension officers to reach them, in some cases the deployed extension officer is not well skilled and therefore fails to assist the farmers appropriately.

Although government has on many occasions tried to assist farmers through farmer support, respondents indicated that although some received agricultural inputs or fodder during drought, they have not been capacitated in dealing with the risks of climate change especially how to prepare for natural disasters in the form of droughts and floods. Some even suggested that government often start projects that are meant to assist them without training and proper monitoring of the project until the end, in most cases the projects fail.

In some cases government puts it as a condition that farmers should group themselves into cooperatives in order to access assistance, farmers feel that it has always been the downfall of many such projects as more people who come into the cooperative just want to be part of the group without any passion to farming or farming skills, as a result they are not able to stand for labour intensity of farming and often set up the projects to failure.

Respondents indicated that in most cases they do not adapt because they do not want but they lack information on weather forecast that is specific to their own areas. Often when they listen to radios on programmes that government utilises as awareness sessions, they are often given general information that is not specific to their areas and often unreliable. They feel that Extension officer's should be strengthened and well capacitated to deal with such issues, more so that more of small scale farmers are not well educated to comprehend this information.

The other areas of interest mentioned by respondents is the issue of research that government needs to assist them especially on soil samples. They indicated that more often than not small scale farmers plant crops not suitable for their soil sample, especially lately where the effects of climate change have taken toll on the fertility of the soil. Most farmers lose their yield due to lack of guidance and proper assistance from extension services.

One participant highlighted during the focus group session, *"we are often told to use more heat tolerant crops, we are not told where to get them, some of them we know, but because of lack of adequate rainfall most of them are extinct."*

Another area of research that respondents highlighted as crucial is the issue of crops and animal breeds that are climate tolerant. Respondents indicated that they would like to be assisted with research to determine which type of crops are weather resistant that they can invest in during extreme weather condition or breeds of livestock that can survive the unfavourable weather. They emphasised that they want to sustain food production through all odds; therefore it is important for them to understand all about climate change to make it easy for them to identify the correct measures of adaptation.

Majority of respondents from Limpopo province indicated that they would want to have more training on the available modern farming implements as well as agricultural inputs. They mentioned that because they are committed to farming, they are hopeful that with appropriate guidance, support and enough awareness on climate change they will be able to adapt fairly enough to sustain their food production, as well as securing their livelihoods.

These are adaptation strategies that were listed by small scale farmers in both provinces. They were also appreciative of the least that government is doing for them under such unreliable climatic conditions and stated that government through its departments of agriculture has initiated programmes such as Fetsa Tlala, Nguni Cattle Development Programme, Comprehensive Rural Development Programme, and so on, but the challenge as the study found out is the skewed allocation of financial assistance on these programme which makes it difficult for small scale farmers not to feel the impact. The government should strengthen their programmes and ensure that the services are received by farmers, as it remains the constitutional right of small-scale farmers to be assisted by government in South Africa.

8.11 SUMMARY

This chapter outlines the findings and results of the study. Two provinces are compared in terms of their similarities and differences, and this is supported by the experiences of small scale farmers in each of the provinces. The profiles of the two provinces are analysed in terms of their key variables such as the biographical information, consisting of education, agriculture, water availability and food availability.

Findings on the impacts of climate change on the livelihood, agriculture, and food security of small scale farmers in both provinces are discussed. The chapter also discusses the coping mechanisms that the small scale farmers have used and the barriers to effective adaptation.

A number of adaptation strategies were identified and discussed. Water conservation and management through irrigation, crop diversity, livelihood diversity, adaptation of mixed farming, switching to more climate tolerant crops and breeds; and adjusting of farming practices, periods of planting and use of new technology and farming equipment were cited as some of adaptation strategies that could assist farmers to adapt effectively to climate change.

The study found that majority of small scale farmers are poor and do not have capacity to adapt, therefore small scale farmers discussed in this chapter the role that they want to see government play in assisting them to adapt to the risks posed by climate change to their effort of producing food for food security. Climate change adaptation efforts need cooperation between government, private sector and all agricultural stakeholders including farmers. However, there is still a feel that government is not doing enough in mainstreaming climate change into its policies and programmes and is not advocating climate change and its impact enough.

CHAPTER NINE

RECOMMENDATIONS AND CONCLUSION

9.1 INTRODUCTION

From the first chapter of this study, it has been clear that climate change is a reality that has potential to wipe out the entire human race if not well managed. Research and studies by different people have indicated that many came to a conclusion that the impact of climate change on food security internationally, regionally and locally needs to be identified and managed with adequate adaptation strategies.

It is also highlighted that since some countries are more vulnerable than others, there is a population that feels responsible for emission of greenhouse gases, which is even prepared to assist the countries without capacity to adapt and mitigate climate change. It was also crucial for the study to look at the livelihood of South Africans and the socio-economic factors such as poverty, unemployment, education, agriculture and their food security; to determine their relations and how government is assisting in managing the risks and impact of climate change. The following recommendations have been drawn on the basis of the findings and the gaps identified during the study.

9.2 RECOMMENDATIONS

Research on small-scale farmers

There should be more research done nationally on small-scale farmers and their food security status. More research is conducted at national food security status during national survey, and the variables are farmers in general, which does not isolate small-scale farmers from commercial farmers. The implication is always that when the status of food security in South Africa is recorded, it appears that nationally people are food secured. This is a wrong picture painted by research based on national survey, which is also used by policy makers to develop national policies. Poor analysis of the impact of climate change will produce poor results on implementation of adaptation strategies. Policies on adaptation should be properly designed and focused on particular vulnerable groups. When policies are formulated it is important to consider the difference and the gap between small-scale farmers and commercial farmers. Proper study on the difference of the two sectors and their potentials would assist to formulate implementable policies that are focused on targeted groups. For example, funding policy that is formulated for farmers and applied in both sectors will somehow disadvantage the other group if both groups are put in the same pedestal. The policies should be biased towards the small-scale farmers in order to enable more of them to participate in farming.

Investments on adaptation and mitigation strategies

There is a need for government and private sector to invest in research on adaptation and mitigation strategies in rural areas in particular, in order to come up with innovative technology for rural farmers. Considering that effective adaptation strategies need funding, the government and private sector should come up with effective strategies to ensure that rural communities are capacitated to deal with the impact of climate change, otherwise the negative implication would spill into other sectors such as economy, health and education.

Research on the effectiveness of small scale farming in rural areas

It is of note that while other people believe in subsistence farming as a strategy to curb food insecurity, there are still others who do not see it as a sustainable strategy more especially considering the impact of climate change. Most respondents in both Provinces cited the shortage of water, shortage of land, shortage of finances and other barriers that reduce their capacity to continue to be effective producers. Therefore it is important to intensify research on whether small-scale farming is still an effective strategy, if not what could be improved to ensure that food security in rural areas is sustained.

Capacity building programmes for Extension Officers and small-scale farmers

Throughout the study, the issue of lack of capacity on the small-scale farmers has been overemphasized. Therefore adequate capacity building of Extension Officers to assist them collect useful information that would enable rural communities to adapt. This could be intensified through regular study groups, farmers' day demonstrations, lectures and media. The Department of Agriculture should do effective advocacy of programmes aimed at assisting farmers so as to spread more knowledge and information about climate change. Traditional authorities should be capacitated to provide this information to their communities as well.

Assistance to small-scale farmers to effectively adapt to climate change.

In order to ensure effective implementation of adaptation strategies, small-scale farmers could be identified and be assisted with drought resistant cultivars during droughts to keep up the momentum. They could also be assisted to diversify their farming according to the severity of the impacts of climate change in their area. In some areas technological developments such as conventional crop breeding, development of transgenic crops through biotechnology could be used to ensure that farmers do not lose their production.

Provision of localised climate data for small-scale farmers

Climate change affects different areas differently so it is important that small-scale farmers are provided with localized climate data in order to enable them to adapt. Integration of indigenous coping strategies and conventional science strategies will assist small-scale farmers to improve on their current strategies.

Investment in water resources

Substantive investment in water infrastructure such as communal dams, flood-resistant storage facilities and resources for reducing water loss needs to be prioritized for rural communities. Communities should be capacitated about climate change and its implications on water shortage. Restrictions should be enforced on communities and industries that use more water such as mining and agriculture in order to manage water control.

Impact assessment on government's assistance to small-scale farmers

Monitoring and Evaluation of government should research the impact made by the Department of Agriculture and other sister departments on projects that were meant to assist the small-scale farmers and determine how many of them did really make an impact in production. If the impact assessment produces negative results government needs to change their strategies and find effective ways of improving small-scale farmer support.

Climate change mainstreaming on policies and programmes of government.

Climate change should be made a policy priority to ensure that it flows from national, provincial, local and sectoral development agendas. This will ensure efficient and effective processes of developmental planning, implementation and monitoring of projects and programmes. More research should be funded and relevant data be collected in order to assist in proper development of policy guidelines and best practices, especially in assessing risks in the changing climate.

Disaster management and prevention strategies

Rural communities should be capacitated on planning and managing disasters. Adequate planning, funding and investments should be prioritised so as to reduce the risks of natural disasters that frustrate farmers due to climate change.

Prioritisation of key sectors to ensure sustainable development

All key sectors such as agriculture, mining, manufacturing, transport, tourism, health etc, be prioritized for investments, skills development and transfer on technology and technical knowledge as capacity to

deal with climate change in rural areas. It has been evident in the study that high economic development brings sustainable food security.

Involvement of small-scale farmers in identifying suitable adaptation strategies

To encourage small-scale farmers to participate in adaptation of the impact of climate change, the communities need to identify suitable and affordable adaptation strategies for implementation. Government and its policy makers should make adaptation to climate change policy priority by mainstreaming it into national, provincial and local, even sectoral development programmes as it is mandated by the National Climate Change Response Policy (2011).

Formulation of policies that support small-scale farmers to produce more food

Small-scale farmers are already facing unfair competition with commercial farmers and, as a result, they do not even make it in their own local markets, let alone competition from international imported produce. For instance, more cheap products are imported into South Africa from developed countries, such as China and America and small-scale farmers find it tough to compete with these giants on cheaper food. It is up to South African government to formulate policies that supports small-scale farmers in their effort to produce food.

Areas of prioritization for government policies

Analysis of the status of food security is done nationally, and does not give detailed picture of impact at household level. National analysis often lacks consideration of difficulties and specific necessities each household or individual person faces with regard to food security. Since it has been confirmed that the small-scale farmers are still willing to continue to produce food amid their challenges, it is important that South African government prioritize policies climate change adaptations and mainstream them in all its programmes and projects. The following areas should be prioritized through policy development that supports the research done on small-scale farmers. (a) Water Management and Control, (b) Financial Assistance, (c) Dissemination of Climate Change Information, (d) More Land for Farming and Grazing, and (e) Improved Extension Services.

9.3 CONCLUSION

Working with farmers and involving them in policy making should be prioritised by government if agriculture has to succeed. Policies that seek to improve the above issues for small scale farmers have great potential to improve their adaptation to changes of climate. Policies need to be in support of small scale farmers' environment and socio- economic status. Government has a role to conduct research that assists policy makers to make informed decision to achieve this research should be supported with policy to enhance the adaptive capacity of agricultural systems.

This chapter discussed the recommendations made on the findings from the discussions in Chapter four, five, six and seven. These recommendations could be considered by the following ministries and organisations, to improve food security, generation of income in order to create sustainable rural development in the midst of current and future climate change.

Ministry of Agriculture and Rural Development

Ministry of Environmental Affairs

Ministry of Local Government and Traditions Affairs

Ministry of Small and Medium Enterprise Development

Ministry of International Relations

Non-Governmental Organisations

Agricultural Organisations

Educational Institutions

Seed companies and Researchers.

Although climate change cuts across all sectors it is recommended that all development sectors should include climate change aspects in their long-term planning.

As the study has identified and recommended the adaptation strategies and coping mechanism to small-scale farmers, it also advocates for scholarships for more research on improving the existing mechanisms and coming up with innovation on new technology that would assist not only small-scale farmers to cope with climate change but the entire rural population. More scholarship in the field of climate change and food security should be provided more to students who have an interest in improving the current situation on the impacts of climate change.

The study has also uncovered the important relationship with international relations scholars. It has been evident that climate change is having adverse effect on food security systems globally and in almost all sectors of the economy. This therefore brings a fresh challenge to the world peace. Shortage of food and water easily brew riots and instability amongst nations, and with proper international relations, scholars can come up with more innovative and strategic solutions to deal with climate change and its impacts on food security.

As it has been evident throughout the study that climate change is a reality, and it is certainly affecting the availability of food, which puts a challenge to human existence. This study contributes to the support of

entitlement theory, as it emphasises the important of adaptation policies and strategies that protects vulnerable people with no entitlement to cope with food insecurity. The study acknowledges the status of food insecurity in rural communities and therefore puts more emphasis on persuading government and private sector, to alleviate poverty as it frustrates the efforts of adaptation to climate change by rural communities.

This study contributes to the assessment of vulnerability of rural population to economic shocks and where necessary suggests their livelihood patterns as coping mechanisms. The household economic approach has also assisted the study to confirm its findings that poor households are not only affected by high prices of food, but by other environmental factors that makes it difficult for them to pursue food production.

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APPENDIX A: List of interview questions for Small-scale Farmers

BIOGRAPHICAL INFORMATION

Gender

Male		Female	
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Age

20-30		30-40		40-50		50-60		60-70	
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Population Group

Black		Coloured		Indian		white	
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Household composition

0-3		3-5		5-8		8-15	
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Occupation

Full-time farmer		Part-time farmer	
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Is there any other member of household employed elsewhere?

Yes	
No	

Source of household income

Farming	
Salaries	
Pension	
Social grants	
Remittances	
No income	
Other sources	

What is the highest educational qualification in the household?

Matric	
Diploma	
Degree	
None	

How long have you been farming?

1 – 5		5 – 10		10 - 20		20 - 40	
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In which category do you classify yourself?

Small-scale farmer	
Subsistence farmer	
Small Holder farmer	
Commercial farmer	

Where do you do your farming?

Backyard garden		Communal garden	
Private farm		Communal land	
School garden		Other	

What are your reasons for being in farming?

As a source of food	
As a source of income	
As extra income	
As extra food	
As a hobby	

Food Security

- 1. How do you acquire food?
- 2. Have you ever run out of food in the last 5 years?
- 3. How often do you eat balanced diet?
- 4. Do you think you have enough water in your area?
- 5. Where do you source water in this area?
- 6. Do you think you are producing enough food to feed your community?
If not what could be your challenges

Climate change

- 1. Are you aware of climate change?
- 2. Where do you get information about climate change?
- 3. What is the impact of climate change on your livelihood?
- 4. What is the impact of climate change on agriculture in your area?
- 5. What is the impact of climate change on your food production?

Adaptation Strategies

1. How have you adapted to the impact of climate change?
2. What are the barriers to your effective adaptation?
3. What indigenous methods do you think could be used?
4. Which effective adaptation strategies would you suggest for farmers in your area?

Role of South African Government.

1. Do you have any relationship with your extension officer? How often do you meet him?
2. Are you aware of government programmes aimed at assisting small farmers to curb food insecurity?
3. In your opinion, how do you think the government should assist small-scale farmers to deal with challenges of climate change?
4. What type of assistance do you think small-scale farmers need from government to sustain food security in rural communities?

APPENDIX B List of interview questions for Government Officials (Department of Agriculture)

1. In your opinion, what do you think is the impact of climate change on food security in this Province?
2. Small-scale farmers in rural areas are said to be the food producers, do you think they cope with the current impact of climate change?
3. How do you think your department should assist them to adapt to the changing climate?
4. What sustainable adaptation strategies do you think can assist small-scale farmers to curb food insecurity?
5. What is the role of your department in addressing the risks and challenges of climate change?

APPENDIX C List of interview questions for Government Officials (Department of Environmental Affairs)

1. In your opinion, what do you think is the impact of climate change in South Africa?
2. Small-scale farmers in rural areas are said to be the food producers, do you think they cope with the current impact of climate change?
3. How do you think your department should assist them to adapt to the changing climate?
4. What sustainable adaptation strategies do you think can assist small-scale farmers to curb food insecurity?
5. What is the role of your department in addressing the risks and challenges of climate change?

APPENDIX D List of Discussion questions for Focus group

1. What do you think is the impact of climate change in your area?
2. Small-scale farmers in rural areas are said to be the food producers, How have they been coping with the current impact of climate change?
3. What sustainable adaptations strategies do you think can assist small-scale farmers to curb food insecurity?
4. What do you think is the role of government in addressing the risks and challenges of climate change?