Midlands State University

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FACULTY OF ARTS

DEPARTMENT OF DEVELOPMENT STUDIES

THE IMPACT OF CLIMATE VARIABILITY ON SMALLHOLDER FARMERS IN ZIMBABWE: A CASE OF MAKONI DISTRICT, WARD 9 (2000-2012)

Submitted By

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DECLARATION

I undertake that all material presented is my own work and has not been written for me by any other person(s). I also undertake that any quotation or paraphrase from the published or unpublished work of another person has been duly acknowledged in my work.

SIGNED……

DATE…….

APPROVAL FORM

I certify that the following student……..

Student Registration Number.....was under my supervision.

I further certify that he/she has attended all the scheduled meetings with me and that he/she has fulfilled all the requirements that I set before him/her as the supervisor.

Supervisor…… **Date…….....**

Chairperson…… **Date……..**

DEDICATION

I dedicate this dissertation to my beloved uncle, Francis E Mudondo for all he has done for me. Thank you very much for your support.

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ABSTRACT

The study explores the impact of climate variability on smallholder farmers in Makoni District and in order to gain full appreciation of the problem, the study zeroed down to Ward 9. The research juxtaposed qualitative and quantitative methodologies because the researcher saw the need to refer to statistic and numeric data in form of quantifiable responses whilst on the other hand the research largely aimed at revealing and unearthing perceptions, attitudes, beliefs and opinions of respondents pertaining climate variability. This article argues that, climate variability is making it extremely difficult for smallholder farmers to invest in their agricultural activities. The findings shows that, climate variability is a reality in Makoni and reported late and unpredictable rains resulting in seasonal variations in rainfall timing, poor distribution of rainfall within seasons, increases in temperatures, successive and prolonged dry spells and increased frequency in droughts occurrence. It emerged in the study that, weather vagaries resulting from climate variability have caused extensive crop failures, deaths of livestock and low crop output. The study highlighted that, all these have compounded the vulnerability of smallholder farmers by dramatically reversing the poverty reducing capacity of agriculture thereby slowly but surely eroding the source of livelihoods for smallholder farmers. The study however established that, Smallholder Farmers should not remain as passive victims to climate variability related hazards; they should rather devise adaptation mechanisms to cushion the impacts of climatic related risks.

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LIST OF ACRONYMS

AGRITEX	Agriculture Extension Office
AEZ	Agro-Ecological Zone
FAO	Food and Agricultural Organisation
GoZ	Government of Zimbabwe
IMO	International Meteorological Organisation
IPCC	Intergovernmental Panel on Climate Change
MDG	Millennium Development Goals
NGO	Non- Governmental Organisation
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme

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1.0 INTRODUCTION

Climate variability is a general alteration of the earth's weather patterns or the way in which the weather conditions fluctuates yearly above or below a long-term or average range. It occurs due to changes in the environment, like changes in its orbit around the sun (natural processes) or human modifications to the atmosphere. Human induced causes of variability include the release of greenhouse gases such as carbon dioxide, methane, nitrous oxide and sulphur into the atmosphere, these anthropogenic GHG emissions depend on numerous driving forces, including population growth, economic development, energy supply and use, land use patterns, and a host of other human activities . According to the Intergovernmental Panel (2001), climate variability refers to variations in the mean state and the occurrence of extremes of climate on temporal and spatial scales beyond that of individual weather events. It generally includes short-term events e.g. drought, floods, tropical storms and long-term events such as changes in temperature, wind and rainfall patterns (WRI, 1996).

The shifts in weather patterns have devastating implications on smallholder farmers due to the fact that, their production is wholly rain-fed. These disruptions appear to be worsening problems such as poverty, malnutrition, and heat stress, lack of water at crucial times, pests and diseases. Agriculture is one of the most vulnerable sector to the risks and impacts of climate variability due to the fact that, it is particularly sensitive to climatic conditions. Climate variability has emerged as one of the most serious Global challenges, having a negative bearing to many societies of the World and is considered to be one of the serious threats to sustainable development. There is a wide scientific consensus that the concentrations of greenhouse gases in the atmosphere are human induced, causing global climate change and variability, Mendelsohn and Dinah (2005). Climate variability exerts great pressure on the agricultural sector which is the mainstay of most Sab-Saharan

economies, thereby undermining the growth of most African countries. It is now a cause of concern to Zimbabwe and the implications are particularly devastating especially to the poor communities of Zimbabwe. Food production in Zimbabwe is particularly vulnerable to climate variability because of its overdependence on rain-fed agriculture and this is justified by the fact that, climate is a prime factor that exerts major influence and control over soil type, water resource and ultimately food production.

1.1 BACKGROUND TO THE STUDY

Since the Earth was formed more than four billion years ago, its climate has periodically shifted from warm to cool and back again – sometimes dramatically (John T. Hardy 2003). The deviations of climatic conditions from the norm and standard course have resulted in climate change. Fossils preserved in ancient sedimentary rocks, provide evidence and a clear background that populations of tropical plants and animals once thrived in Europe and elsewhere in the globe. Sheets of glacial ice, a mile thick, covered much of North America only 20,000 years ago. To clearly show that climate variability is not a new concept to Europe and the rest of the world, it dates back to centuries, in 1896, Europe experienced “the year without a summer,” and widespread crop failure resulted in food shortages and political unrest (Gore 1993). In New England in that same year, it snowed in June and the immediate cause of the global cold spell was a series of massive volcanic eruptions in Indonesia, which released huge quantities of dust particles in the atmosphere thereby reducing the amount of sunlight from reaching the planet Earth (Hardy 2003). This evidence clearly illustrates the idea presented in the above introduction that, climate variability is caused by a combination of natural processes and unnatural processes.

About 8,000 years ago Saharan Africa, now an arid desert, was home to numerous wetlands and lakes, variations in rainfall patterns and temperatures have actually resulted to aridity in

this region of Africa. The Sahel region in Africa has become vulnerable to climatic variations due to its geographical location on the edge of the Sahara desert and the dependence of its population on rain-fed agriculture and livestock. Agriculture remains at the heart of Africa's economy or the primary sector which employs more than 60% of the active population and it contributes 40% of the Gross Domestic Production (GDP) of the region. Rainfall variability is one the factor that that combine to make life extremely difficulty in this part of the world by causing massive losses in agricultural production and livestock losses.

Clever Gomba (2012), points out that, volatile weather patterns, swinging between extremes, coupled with changes in annual precipitations and temperatures, have the capacity to reshape the productive landscape of the entire world and to exacerbate food, water and energy scarcities in the world. As a result, climate variability and change as subject has attracted global solidarity to curb these impacts; various International bodies and statues were formed. Much of the knowledge on climate variability and change comes from the global scientific and technical programmes co-ordinated by WMO. WMO has inherited an interest and involvement in the study of climate change from its predecessor, the International Meteorological Organisation (IMO) which was created in 1873. In the 1929, it already had a technical working Commission to study on climate variability issues and climatology. In 1979, the WMO convened in Geneva the First World Climate Conference in collaboration with other organisations of the United Nations. In 1988, the Intergovernmental Panel on Climate Change was established jointly with the WMO and the United Nations Environmental Programme (UNEP) to study all aspects of possible climate variability and change including studying its social-economic implications (WMO, 1992). The background of global collaboration to climate variability can be continued, to the establishment of the Framework Convention on Climate Change which was adopted in 1992, in New York to the Kyoto Protocol treaty which was adopted in December 1997 aimed at cutting down emissions

levels by encouraging Developed World to undertake de-growth and financing Developing state's mitigation and adaptation measures. Global solidarity is mainly because climate variability and change is common to all nations, and it creates an alternative path to scarcity and collapse of world economies and social well-being.

Zimbabwe is a developing landlocked country with a total population of about 12.5 million; a significant proportion of the population is dependent on exploitation of environmental resources for their livelihoods and sustenance Bessie F Madziwa et al (2013). It is one of the countries in the sub-Saharan Africa which relies heavily on weather conditions on its agriculture. According to the country report by Chagutah T (2010), Zimbabwe's climate is mostly semi-arid. The country lies in a region with limited and unreliable rainfall patterns, and has a national mean rainfall of 655 mm. Mean annual rainfall ranges from 300 mm in the low- lying Limpopo Valley in the south to over 3000 mm per annum in some high mountain areas to the east. The rainy season extends from November to March with a peak in January, during which time rainfall exceeds 100 mm over most of the country. The rainfall regime is predominantly free convection associated with the Inter-Tropical Convergence Zone (ITCZ). Inter-annual variability in rainfall is relatively high, ranging from 16% on the northern plateau to 48% in the Limpopo River Valley (overall mean 29%) Frost (2001). He further assets that on average, one to three droughts used to occur in every ten years, largely due to changes in the phases of the El Niño-Southern Oscillation (ENSO) phenomenon and periodic sea surface temperature changes. Annual evaporation ranges were recorded at 1400 mm in the cool eastern highlands to as high as 2200 mm in the hot low-lying areas to the south and north of the country. The relatively high elevation of most parts of Zimbabwe, especially the central watershed, has a moderating effect on temperatures. Most parts of the country, therefore, enjoy temperatures that are generally lower than might be expected for their latitudes. The mean annual temperature varies from 18oC in the Highveld to 23 degrees

Celsius in the low veld. The Highveld experiences some frost in June or July most years, and temperatures rise up to 30 degrees Celsius around October. In the low veld, temperatures rarely fall below 2 degrees Celsius in winter but can rise to over 4 degrees Celsius in summer GoZ (1998). It is important to note that, the end of the twentieth century, Zimbabwe was a warmer and drier country than it was at the beginning. Annual mean temperatures had increased by about 0.4°C since 1900, and rainfall had declined by nearly 5% across the country. The 1990s were on record as the warmest and driest decade of the century GoZ/ UNDP (2007). Temperature analysis results from meteorological stations in most parts of the country indicated a rise in daily minimum temperatures of around 2.6°C, coupled with a rise in daily maximum temperatures of about 2°C in the last century. This is clear evidence that, climate variability has not spared Zimbabwe for the last two decades.

The study was conducted in Makoni District which is divided into 31 national electoral wards for administration purposes. To gain a deep appreciation of the problem the exercise zeroed in on Ward 9 which is 21 kilometres from Makoni town (Rusape). It is interesting to note that, the District is comprised of all the five Agro-Ecological regions basing on the boundaries by Vincent and Thomas (1960) and Ward lies in the Natural Ecological Region III, according to the Ministry of Agriculture Department of AGRITEX of Makoni District. According to AGRITEX, more pronounced Agro-ecological zones in the district are I; II; III and IV covering the extreme North and South parts and region 5 which covers Ward 31 or Nzvimbe area. Region III receives annual rainfall which ranges from 600 to 650 mm annually and the agricultural system in this region in semi-intensive in nature. The soils in the Ward or Nyahava resettlement ranges from course sands to sandy clay loams, inherently low in Nitrogen, Phosphorous and organic matter (Anderson et al, 1993). Prior to the Zimbabwean Independence in 1980, Nyahava was dominated by extensive large-scale livestock rearing and tobacco farming and was only opened by the government of Zimbabwe for resettlement

to relieve population pressures to overpopulated areas, Mutambanengwe and Mapfumo (2005). Underutilised large scale commercial farms were acquired for this purpose of relieving population densities and smallholder farmers were therefore settled in this place. However, at a later stage, the study will highlight that, climate variability has resulted in alterations in the above climatic conditions in the area of study.

1.2 STATEMENT OF THE PROBLEM

Given the overreliance of small holder farmers to rain-fed agriculture, seasonal fluctuations in weather patterns undermine their agricultural production. Climate variability induced hazards have caused extensive crop failure and had also resulted in unsustainable marginal lands for livestock production. The major reason being that, deviation of weather patterns especially during the summer season is a major determinant for livestock and crop output. Thus this study aims at examining the impacts of climate variability to smallholder farmers in Makoni District.

1.3.1 OVERALL OBJECTIVE

- To examine the effects of climate variability on smallholder farmers in Ward 9.

1.3.2 SPECIFIC OBJECTIVES

- To examine the effects of climate variability on smallholder crop production.
- To explore the impacts of climate variability on smallholder livestock production.
- To explore strategies that can be implemented in order to reduce the impacts of climate variability in the context of climate variability.

1.4 RESEARCH QUESTIONS

- What is the impact of climate variability on smallholder farmers?
- What are the effects of climate variability on crop production by smallholder farmers?
- What are the implications of climate variability on smallholder livestock production?
- What adaptation measures can be put in place to curb the impacts of climate variability on smallholder farmers?

1.5 SIGNIFICANCE OF THE STUDY

- **The Researcher**

  The researcher will be equipped with skills as part of the fulfilment of the BA Honours' Degree in Development Studies at Midlands State University, techniques, strategies and knowledge would be obtained for future researches. The researcher will also be equipped with information that will be acquired during the research period and that information might very useful in the future.

- **The District**

  To the District, the information may actually raise awareness to the stakeholders on the need to mainstream environmental issues during policy design, implementation and monitoring and evaluation. Strategies to reduce the impacts of climate variability will also be proffered by this study.

- **The Smallholder Farmers**

  The grassroots community members are also expected to benefit through their active involvement in the research which will raise their level of awareness on climate variability is a serious phenomenon and as a global issue of concern. The study will

also help smallholder farmers to come to a realisation that, they should alter their farming systems to reduce the impacts of variability on their livelihoods.

- **Midlands State University**

Finally to Midlands State University, this study will act as source of information to other related studies and the study will also enhance the information basket for use by future researchers.

1.6 ASSUMPTIONS

- Agricultural activities directly depend on weather patterns and the weather patterns are as a result of climatic conditions.
- The research also assumes that people in rural settings thrive mainly on rain-fed agriculture.
- Climate variability has resulted in increased droughts and more uncertainty about the onset and cessation of rain.
- Climate variability is impacting negatively on smallholder food production.

1.7 DEFINATION OF TERMS

- **Climate variability:** The way climate fluctuates yearly above or below a long-term average value. Climate variability refers to variations in the mean state and the occurrence of extremes of climate on temporal and spatial scales beyond that of individual whether events (IPC, 2001.) Climate variability includes short-term events such as droughts, floods, tropical storms and long-term events such as changes in temperatures and rainfall patterns.

- **Climate Change:** If climate variability is year-to-year variation, what is climate change? Climate change is a long-term continuous change (increase or decrease) to average weather conditions (e.g. average temperature) or the range of weather (e.g. more frequent and severe extreme storms). Both can also happen simultaneously. Long-term means at least many decades. Climate change is slow and gradual, and unlike year-to-year variability, is very difficult to perceive without scientific records.
- **Global warming:** The term is a specific example of the broader term, 'climate change'. Global warming is the increase in the average temperatures of the earths near surface air and oceans in recent decades and its projected continuation (IPCC, 2001).
- **Smallholder farming:** Farmers produce for their families, for domestic and sometimes national markets. The land tenure system for smallholder farmers is communally/village owned. Lipton (2005) defines the small-holder farms as operated by family and the means of labour coming from the family, also defined as those with few assets. Smallholder farmers also take in part in different activities on their farms. In-between seasons, small holder farmers have livestock and gardens that need constant attention. Therefore life on the farm is a continuous circle of work to be done all year round.
- **Agro-ecological zones:** are land areas representing unique combinations of homogenous agro-climate, ecology, soil units and agricultural activities (FAO, 1978).
- **Ward:** a local government administrative unit with between 1 000 – 1 500 households.

1.8 LITERATURE REVIEW

The section is a detailed account of what different scholars have written about the research topic and will try to explain the relevant aspects that are related to this study. Quite an amount of literature has been written on climate variability and its impact on agricultural production in Zimbabwe. However in Zimbabwe, research and literature on the impact of climate variability on smallholder farmers as well as the adaptation strategies devised by the rural poor is scant if not non-existence. Much focus by various scholars has a bias towards the commercial agriculture neglecting implications of climate variability on smallholder farmers of which the majority of Zimbabweans live in rural areas undertaking agricultural activities as a major source of sustenance. Thus it can be noted that emphasis was placed on the implications of climate variability on cash crop production at the expense of subsistence agriculture in Zimbabwe. This paper sought to fill this knowledge gap by exploring the impact of climate variability on smallholder crop and livestock production and the adaptation strategies devised by the rural poor in Makoni District. It is important to note that, much of the available literature on climate variability has been undertaken in developed countries of the world and in the urban communities thereby ignoring its impacts on smallholder farming communities that often proffer more complex and different realities of the phenomenon.

Apart from this negligence, available literature dwelt much on long-term climatic changes (climate change) and how it has impacted negatively on agriculture, however this study is going to fill this gap by focusing on short-term or seasonal climatic means (climate variability) in explaining crop yields by smallholder farmers. Worth noting is that, available literature on climate variability and smallholder farmers is quantitative in nature, scholars have relied much on stakeholders like Agritex, Zimbabwe Meteorological Service Department and Central Statics Office (CSO), for information without engaging farmer

perceptions yet they are the ones on the ground, and does know and have experience on deviations of climatic conditions and the consequences it has on their agricultural production. Therefore it is the purpose of this study to add more literature on climate variability and its implications on smallholder farmers using a mixed research methodology, which is making use of both quantitative and qualitative techniques.

Climate variability refers to variations (ups and downs) in climatic conditions on time scales of months, years, decades and these variations include changes in rainfall, wind and temperature patterns. Climate variability is indicated by erratic rainfall, reduced rainfall and increased or reduced temperatures which therefore lead to crop productivity decline and increased livestock morbidity and mortality. According to the information that is available on internet, due to climate variability, some years have more overall precipitation and other year's experiences inadequate rainfalls. Even though people are fairly perceptive of climate variability, it is not as noticeable as weather variability because it happens over seasons and years. Evidence includes statements like: "the last few winters have seemed so short," or "there seem to be more heavy downpours in recent year," www.miseagrant.umich.edu/climate. The source further assets that, "if climate variability is year-to-year variation, what is climate change?" Climate change is a long-term continuous change (increase or decrease) to average weather conditions (e.g. average temperature and rainfall) or the range of weather (e.g. more frequent and severe extreme storms). Both can also happen simultaneously. Long-term means that, at least many decades. Climate change is slow and gradual, and unlike year-to-year variability, is very difficult to perceive without scientific records. Therefore this study as highlighted in the above introduction will be focused on short term or seasonal variations because the researcher feels that, there is overemphasis on long-term climatic shifts at the expense of climate variability with regards to smallholder farmers in Zimbabwe.

There is wide scientific consensus that concentrations of greenhouse gases in the atmosphere are increasing due to human activities, causing global climate change (Mendelsohn & Dinah, 2005 and Rosenzweig & Solecki, 2009) and that the inevitable global warming will have major impacts on the climate worldwide (Intergovernmental Panel for Climate Change [IPCC] 2007). According to Rosenzweig and Solecki (2009), although the climate system includes a great deal of natural variability, climate fluctuations have always been part of the Earth's 4.6 billion year history. However, changes in concentrations of greenhouse gases in the atmosphere over the past century are of an unprecedented rate and magnitude. In the same respect, the probability that climate change is already occurring and that past emissions of greenhouse gases have already committed the globe to further warming of around 0.1°C per decade for several decades is high (Mendelsohn & Dinah, 2005 and Solomon et al., 2007). The IPCC and scientists who have worked over several years have provided evidence of global warming and have reached the conclusion that the source is mainly anthropogenic (United Nations Development Programme [UNDP] 2004). Global warming has largely been attributed to a build-up of Greenhouse Gases (GHG) in the Earth's atmosphere, largely resulting from the burning of fossil fuels by the industrialised countries since the beginning of the industrial era. The IPCC Fourth Report (2007) dispels any uncertainty about climate change and gives detailed projections for the 21st century which show that global warming will continue and accelerate.

The foregoing literature explains causes of climate change and attributes industrialisation as the main contributor to global warming, however the researcher feel that there is over emphasis on factors like industry and agriculture at global level as perpetrators of climatic variations. It is important to note that deforestation in rural areas of Zimbabwe for example in the area of study has played an important role in altering weather patterns. Smallholder farmers rely on fire wood as a source of energy, and this has led to extinction of forests and

scarcity in vegetation cover (a factor that controls climate) in rural Zimbabwe and this has negatively altered wind patterns and humidity in the atmosphere by reducing the rate of transpiration. Deforestation as a result of lack of renewable sources of energy like electricity has caused destruction of natural carbon sinks and this has resulted in concentration of carbon dioxide in the atmosphere. The researcher feels that, the global leaders are focusing much on reducing the emissions by industries through International treaties, it is indeed a noble initiative but there is need also to avert climate variability in rural communities by providing them with other sources of energy in order to curd deforestation.

Earlier work by Vincent and Thomas, 1960 dived Zimbabwe into five Agro-ecological Zones with the best agricultural sustainability being in Regions I to III and least in Region 5. Zonation was based on mean annual rainfall, soil quality and also temperature ranges. However scholars have argued that, the current zones developed in the 60s have become redundant and cannot be used to plan sustainable agriculture in the context of climate change. Makarau (1999) noted increased variability of rainfall, rain days and temperature in Zimbabwe; these are possible pointers of climate change and variability. According to a Research that was carried out by Mugandani (2012), major shifts have occurred in the Agro-ecological regions, variations in weather conditions have also affected Natural Regions 2 and 3 which were once the main food production regions of Zimbabwe. Mugandani asserted that, Natural Region 2 has shrunk by 49% while region 3 shrunk by 14%. These changes in regions two and three clearly points out to a possible reduction in Food production in the country. Mugandani et al (2012, p365-367), further asserts that, regions 4 and 5 have expanded by 5.6% and 22% respectively. This provides ample evidence that, Zimbabwean climatic conditions are drifting towards relatively arid conditions that are not favourable for agriculture. Therefore one can note that, despite other factors that have affected agricultural sector such as the agrarian land reform, climate variability has played a major role in

destabilising Zimbabwe's food production and as result, during the 2011/2012 the country was forced to import over 50% of its maize, The Zimbabwean (2012) Agriculture is a critical mainstay for local livelihoods and the National GDP, about 70% (majority) of the population is dependent on farming for a livelihood, however it is important to consider that 80% of Zimbabwe is subjected to conditions which makes dry land cropping a risky undertaking due to low and erratic rainfall Mendelsohn and Dinah (2005). Thus the paragraph was providing ample evidence that, the Agrarian Fast Track Land Reform is not only the limiting factor to Zimbabwean Food security. Various schools of thought have pinpointed the Programme as if it is the only drawback to food production in the country yet the sensitivity of agriculture to climatic conditions has made it a vulnerable sector to the risks and impacts of global climate variability.

Much of the current literature on the science of climate variability confirmed it to be taking place, arguing that the onset of the rainfall, which is the summer season, is now coming late and cessation time is coming earlier than before. Therefore, this has made it difficult for small holder farmers to grow crops that in the past years used to thrive and flourish in any given area. This was also confirmed by the Zimbabwe Metrological Services Department (2002) who argued that rainfall in Zimbabwe since 1980s has been deviating more from the mean in a negative manner thereby amplifying the already existing problems to small holder farmers in the country. Due to this variability or deviation of weather patterns (rainfall, wind patterns, humidity and temperatures) most parts of Zimbabwe are becoming warmer and drier (Low, 2005). This has been evidenced in most districts of Zimbabwe thereby justifying the above evidence that, the agro-ecological zonation by Vincent and Thomas have actually became redundant in the context of climate change. It is important to note that climate variability in different districts of Zimbabwe or in the sub-Saharan Africa at large has become common and some of the evidences does not require scientist with their sophisticated

machines to approve but can be read or interpreted by human naked eyes. River flow has actually decreased since 2000, most rivers which used to flow all year round (perennial) in the past decades are now seasonal (ephemeral) and some have dried up as a result deviation of rainfall from the mean in a negative manner and also increased temperatures which amplifies loss of water in the water bodies by evaporation. For example in Zimbabwe some of the river courses that were once perennial that had actually become sessional, these include the Mushandike, which used to sustain the Mushandike irrigation scheme, Runde and the Save rivers in Masvingo districts and the Nyan'ombe river in Nyanga district had not necessarily become seasonal but severe decrease in discharge has been evidenced along the course.

Climate variability has posed a major threat on food security in Zimbabwe, and this has led to many Developing nations to heavily rely on foreign aid in the form of food hand-outs to avert hunger. According to Shakespeare Hamauswa et al, the shift in climatic conditions over the sub-Saharan regions towards semi-arid to arid conditions has stemmed up a lot of concern as to whether Africa can feed itself. The past two decades have been characterised by an erratic precipitation patterns over the rest of the Country (Zimbabwe) and significant decline in the amount of rainfall. This has resulted in droughts which have significantly affected food production by smallholder farmers in Zimbabwe. The occurrence of drought has had implications on the wider economies in SSA; Zimbabwe as it has reduced crop yields, unsustainable marginal land for livestock. These have all resulted in the erosion of income sources for the region at large (FAO 2004).

Climatic conditions in Zimbabwe have been very unpredictable; in 1981/2; 1991/2 and 2001/2 Zimbabwe experienced severe droughts but 2000/01 and 2002/03 were characterized by severe flooding after cyclone Eline and Japhet floods of respectively (Gwimbi, 2009). Low lying areas in the Zambezi and Limpopo basins have been subjected to devastating

floods in the last two decades, leading to loss of life and property as well as costly damage to infrastructure (Magadza, 2004). Cereal production in Zimbabwe, for instance, declined by 34% during the 1994-1995 seasons due to drought (SADC, 1996). The 1991-1992 droughts, for example, resulted in a fall in agricultural production of 45% and a decline in the aggregated Gross Domestic Product (GDP) of 6% in Zimbabwe. The main impact of climate variability is the decline in crop productivity due to change in rainfall pattern and amounts. Livestock production is also a challenge due to lack of good quality grazing grass and lack of drinking water

According to FAO 2008, cited in a Journal by Constantine Munhande et al, in addition to causing extensive crop failures, chronic dry spells are resulting in livestock deaths, which is detrimental to longer-term agricultural development as livestock production is a key livelihood activity in Zimbabwe's communal areas and animals are difficult and expensive to replace. With the above conditions at stake, one should be in a position to assess that smallholder farmers will be at greater risk as a consequence of livestock death because livestock dating back to pre-colonial era is a source and a form of wealth. This study by FAO indicated the longer term agricultural development yet it should be considered that climate variability has got immediate effects on the household which in this case requires sustainability and that why the researcher have already pointed out that, most literature tended to focus much on long term change undermining short-term changes in weather patterns which had undermines smallholder farming activities. Climate variability in the form dry spells, delay in the onset of the rainfall season, early and sometimes late cessation of rainfall have directly influenced crop and livestock production by smallholder farmers. Smallholder farmers may not be able to replace livestock because they need money to purchase them and their income sources are constrained by the nature of their activities such

as crop farming which is also under threat from climate shocks Rungano Mapfugautsi and Constantine Munhande (2013).

According to a study undertaken by Gandure and Drimie (2011) points out that, livestock including small stock and poultry, are an important source of livelihood and income to smallholder farmers. Households use savings to buy livestock and use income from livestock to pay school and medical fees and to buy food. This reveals the importance of livestock as a livelihood source and the reason why smallholder farmers are more vulnerable to climate variability. Furthermore Climate variability affects the distribution of tsetse flies which carry sleeping sickness and the cattle disease, and the tick-borne livestock disease called East coast fever, or corridor disease (Hulme & Sheard, 1999). Smallholder farmers will face a greater challenge as a result of these diseases because they have low resource and income endowments and may not be able to take the necessary actions against the infestation of these diseases. Livestock are a source of draught power, meat and a source of income to sustain livelihoods, hence livestock diseases have resulted in most smallholder farmers losing cattle and are forced to kill or dispose them to keep pace with the conditions.

A study by Downing (1992) showed that adaptation has the ability to reduce the impacts of climate variability on smallholder farmers in Africa from 50% to 20%. Magadza (2004) defined adaptations as actions taken to help communities and ecosystems moderate, cope with, or take advantage of actual or expected shifts in climatic conditions. Various literatures on strategies that can be implemented to climate variability and change proved to have relied much on relevant stakeholders like the government yet the smallholder farmers knows better on what can be done to reduce the impact of climate variability. This paper therefore focuses much on the part of smallholder farmers. Adaptations may be done by modifying a traditional approach or by taking a new approach depending upon the challenge being addressed. Adaptation measures for crop production may include, early planting, dry planting, use of

drought tolerant crops, use of wetland to extend growing season length, livelihood diversification into non-agricultural activities, mulching and terracing among many other strategies. For livestock production the measures by the smallholder farmers may include, harvesting crop residues (Stover) and keeping it for the dry season, supplementary livestock feeding, diversifying into small ruminants from cattle production (Downing, 1992). Literature on the role of other stakeholders in averting climate variability, includes that, the government can put both reactive and anticipatory adaptive measures into place through policies on infrastructural developments, research and development, product pricing, education and water resources management. Economic policy adjustments include shifts in regional production centres and adjustments of capital, labour, and land allocations. For example, trade Adjustments can help to shift commodity production to regions where comparative advantage improves; in areas where comparative advantage declines, labour and capital may move out of agriculture into more productive sectors (Matarira et al, 1995).

As an adaptation method to climate change and climate variability especially the bridging of dry spells, conservation agriculture is being promoted in Zimbabwe. The farmers are moving away from the intensive soil preparation which is major driver of land degradation. Often, farmers unknowingly through hoeing or ploughing with combined removal or burning of crop residues leaves the soil exposed to climatic hazards such as rain, wind and sun (Rockstrom et al., 2009). Rainwater harvesting techniques such as planting pits and basins which can achieve considerably high rainwater use efficiency are sometimes incorporated under conservation agriculture Rumley O (2007). Conservation tillage increases soil water retention in the face of drought while also sequestering carbon below ground (IFRI, 2009). Although numerous studies have been carried out in Zimbabwe on impacts of climate variability on agriculture and adaptation strategies, there has been little focus on farmers' views and perceptions which is vital in terms of coming up with effective climate adaptation policies to

climate change. Therefore this study will collect data from the smallholders in order to solicit for farmers' perceptions on mechanisms to avert climate variability.

1.9 DELIMITATION (SCOPE OF STUDY)

The research focuses on the effects of climate variability in Makoni District Ward 9 which lies in agro-ecological region III.

1.10 RESEARCH METHODOLOGY

1.10.1 RESERCH DESIGN

The research design to be used in this study is the descriptive research. The researcher felt that the research had a touch of descriptive research. This design is considered to be the most frequently used method in educational research as it describes what the researcher sees over and beyond the horizon. Chiromo (2006:29) notes that a research design is concerned with turning a research question into a testing project of which this has been considered a blue print for almost all the studies dealing with at least four problems namely, what questions to study, what data is relevant, what data to collect and how to analyse the results. The study was largely grounded in both quantitative and qualitative research methodologies because the researcher saw the need to refer to statistic and numerical data in form of quantifiable responses whilst on the other hand the research aimed at revealing and unearthing perceptions, attitudes, beliefs and opinions of respondents pertaining to climate change.

1.10.2 POPULATION

Fraenkel and Wallen (2003) define population as a group to whom the researcher wishes to generate the results of the study and this implies that the population is the group of people

which the study is about and this is defined as the target population. The Ward is made up 20 villages with a total of 143 households or farmers. The researcher begins with identifying the population before coming up with a research sample and in this study; the population was then comprised of 30 smallholder farmers. In addition to the smallholder famers, 5 key Informants from relevant stakeholders with specialised knowledge on climate variability and its impact on smallholder farmers in Makoni were also interviewed. They encompassed of 2 AGRITEX officers from crop and livestock departments, 1 Met Officer and 2 officers from a local NGO working on climate variability. Other 5 key informants were drawn from the sampled farmers that are out of the 30 farmers, 3 prominent farmers and 2 elders the reason being that, they are well versed with rural livelihoods in relation to climate variability. Key informants from AGRO-Germany a local NGO were selected because NGOs use participatory approaches to development (bottom up) as compared to Government services departments which are blue print in nature therefore their information is largely a reflection of what exists on the ground.

1.11 SAMPLING

1.11.1 SAMPLE SIZE

According to Bleek there are prescribed sampling percentages for different sizes of populations. He further asserted that, these percentages help to create a sample that reflects the utmost representation. Therefore, for the total population size of 143 households or farmers in Ward 9, the prescribed population is 20% which amounts to a sample size of 28. However for the purposes of this study, sampled farmers amounted to 30. The researcher also sampled the villages using the prescribed population percentages. Therefore out of 20 villages, the researcher's sample stood at 4 villages. In addition to smallholder farmers, 5 key

informants were also interviewed and 6 others (2 elders and 3 prominent farmers) who were drawn from the sampled farmers. Therefore the total sample size amounted to 35 respondents.

1.11.2 SAMPLING PROCEDURES

The researcher employed both probability and non-probability sampling approaches for the purposes of this research. With probability sampling, every element of the population bears a chance of being selected in the sample. The population consisted of 143 households or farmers in Ward 9 of Makoni District. As indicated above, the researcher sampled 4 villages which are a representative of the total 20 villages in Ward 9. To eliminate bias in the study, the researcher employed stratified random sampling which gave equal chance for members to be selected in all sampled villages. Therefore the researcher stratified the sample according to villages thereby making village the strata. To this end, the researcher then selected 7 farmers at random from the 4 villages and additional 2 at random again from one of the strata to make up a sample of 30 farmers.

Apart from the above technique, non-probability sampling in the form of purposive sampling was also employed by the researcher as she conducted interviews with information rich key informants. As already indicated, these constituted 2 AGRITEX Officer (livestock and crop production departments), 1 Agro-met Officer and 2 officers from AGRO-Germany a local NGO, 3 prominent farmers were also interviewed as well as 2 elders. Therefore the researcher was able to obtain specific and rich information from the key informants.

1.12 RESEARCH INSTRUMENTS.

1.12.1 QUESTIONNAIRES

Questionnaire were also employed by the researcher because personal attributes do not influence data collection hence chances of interviewer bias will be eliminated. They were administered to smallholder farmers who constituted the sampled population. Questionnaires also provide a permanent and verifiable record of the data collection efforts. However, this method has its own short comings, open ended questionnaires are difficult to analyse and to solve this problem, the researcher is going to use closed ended questions on questionnaires. The questionnaires are also going to be written in English assuming that everyone is able to read and write and the researcher will be explaining any misunderstandings to respondents.

1.12.1 INTERVIEWS

Interviews are the main instruments in gathering primary data from both key informants and the community. The researcher also made use of an interview guides specifically designed for key informants. They involved face to face communication with the respondents. Other interviews were conducted to interviewees who responded to questionnaires to further their interest. The interviewer is going to write simple word answers during the interview sessions and expand them into sentences immediately after the interview in order to avoid interruptions or stoppages. Thus because of limited time structured interview on the specific aspects of the research is going to be used by the researcher to elicit correct responses. However interviews are subject to personal bias and this short coming is going to be addressed by the use of questionnaires.

CHAPTER 1: AN OVERVIEW OF CLIMATE VARIABILITY IN ZIMBABWE

1.1 INTRODUCTION

The chapter aims at highlighting that, climate variability is a reality in Zimbabwe as evidenced by oscillatory trends in climatic conditions since 2000 to 2012. To clearly show the deviations in weather patterns, the chapter will give a detailed account on rainfall and temperature variability in the country. This shall be done by examining trends on, the onset and cessation of the summer sessions in the new millennium, analysing seasonal and monthly precipitation trends especially of the summer season, also increases in annual temperature ranges in Zimbabwe during the period 2000 to 2012 as indicated above. Furthermore the chapter will outline the negative correlation that exists between agricultural sector in Zimbabwe and climate variability. The relationship tends to be sour due to the fact that, rain-fed agriculture which contributes the majority of Zimbabwean agriculture is vulnerable to the risks and impacts of global climate variability. Occurrence of extreme weather conditions mainly inform of droughts and floods in the New Millennia (2000-2012) was also highlighted in this chapter as pointers of climate variability in the country. On the occurrence of extreme weather conditions the chapter will be focused on frequency as pointing to variability because studies and oral messages indicated that, in Zimbabwe, droughts used to occur after 10 years as evidenced by the trend 1972, 1982, 1992 and 2002. However in the recent years, the trend has shifted, rather there is no recognised pattern, droughts are just recurring one after the other and the condition has been made worse by the fact that, even when there is no drought, dry spells have become very common across the country, there is no Agro-ecological Region that is being spared out. Finally the chapter will give a detailed account of the shifts in Agro-ecological Regions by Vincent and Thomas in 1960.

1.2 CLIMATIC TRENDS: RAINFALL AND TEMPERATURES DURING THE PERIOD 2000-2012 in Zimbabwe.

1.2.1 RAINFALL VARIABILITY

Since the turn of the new millennium, the country has experienced a myriad of constraints which were exacerbated by climate variability which manifested itself in form of oscillatory rainfall and temperature trends in the country. Majority of farmers perceived shortening of rainy season and increased variability in intensity and distribution. According to Unganani L. et al (2010) cited a Journal by David Chikodzi et al (2013), rainfall variability has become markedly wide in the country with the onset of the rains changing, the rains are now coming in late most of the times (onset and cessation of the summer season). The dry spells are also increasing and they are a clear indication of poor rainfall distribution during the summer seasons, this is really having profound implications on the crop production rhythm of the country. He further asserts that, the cessation of rainfall has also become very much unpredictable with rainfall periods extending into June and July and sometimes ending much earlier in March.

The frequency and magnitude of flooding has also increased in Southeast of Zimbabwe due to increasing frequency of land falling tropical cyclones within the Save-Limpopo Basin Simba F et al (2012).Steven Jerie and Ndabangani T (2011) argued, in Zimbabwe the threat posed by rainfall variability has not been taken seriously and the extent and nature of the impact has not been studied adequately and very little is known about the extent of the damage that has been caused by rainfall fluctuations. Makarau and Zhakata (2000) also assert that rainfall is a highly variable climatic parameter both inter- annually and intra-seasonally. However, in spite of the significant contribution of reliable and stable rainfall to agriculture, these oscillations have not been examined fully. In Zimbabwe, the climate is characterised by a history of rainfall oscillations which tends to vary in lengths and intensities. Periods of

prolonged dry spells have characterised the majority of rainfall seasons in the country especially during the new millennia.

Dr Priscah Mugabe the Director of the Institute of Environmental Studies at University of Zimbabwe has also noted effects of climate variability as reflected in rainfall patterns in Zimbabwe 1901 to 2009. Mugabe says there have been notable shifts on the onset of the rains, increased frequency of heavy rainfall events, more low rainfall years, increased proportion of tropical cyclones reaching high intensity, drizzle weather conditions have declined and mid-term dry spells have become more frequent and intense. She further asserted that there are more variations in patterns than in amounts.

According to Hulme and Sheard, (1999) there has been an overall decline of about 5% in rainfall across Zimbabwe during the last century. Since 1976 there has been a tendency of the El Nino warm phases of the ENSO to dominate resulting in reduced rainfall occurrences over the country (Hulme & Sheard, 1999). Rainfall variability had been mainly attributed to the El Nino-Southern oscillation over the country. If the perceived trends of a warming climate and reduced rainfall are anything to go by, then Zimbabwe due to its continental location is expected to experience warmer temperatures than other areas (Hulme & Sheard, 1999). Furthermore a decrease in rainfall is anticipated over the whole country and this will have a negative bearing on the agricultural sector and the economy at large that is heavily sustained by agriculture.

Analysing Seasonal and monthly precipitation trends from the period 2000-2009, the Zimbabwe Meteorological Services Department observed negative precipitation trends during the summer period MSD (2005). The department further asserts that, the month to month rainfall totals reveals an increasing rainfall trend in the months of October and December and a decrease in the trends during December, January, February and March. Henceforth, it can

be noted that, rainfall variability is indeed a reality across the country. Furthermore, another research by David Chikodzi et al (2013) carried out in the Southeast parts of Zimbabwe highlighted that, there is noticeable increase in departure from normal rainfall patterns during the last two decades. Rainfall in the region shows a fluctuating trend slightly above the mean and marked increase in the magnitude of years of below average rainfall since 1980. Thus the study unpacks that, there tends to be a gradual fluctuation in rainfall patterns from year to year with more incidents of below normal rainfall than above normal.

Henceforth, climate variability is evidenced across the country through the oscillatory rainfall trends during the last years. Other manifestations which clearly highlight rainfall variability include recurrence of dry spells during the summer season, an increased trend towards a late start of the rain season and a shorter growing season. Climate variability has made the rainfall patterns to be erratic, unreliable and difficult to predict and this spells out the dire need of the farming community to start adapting to these variations.

1.2.2 TEMPRERATURE VARIABILITY

According to the Department of Meteorological Services in Zimbabwe, there is an increasing trend of hot days during the period 2000 to 2013. The MSD (2005) postulates that there is a distinct trend towards higher temperatures in the country, both annual mean and maximum are showing an increasing trend. The service department also asserted that, there is a trend towards decreasing number of cold days as a result of climate variability and a noticeable increase in amplitude and duration of the mean annual deviations from the long-term average. According to a study carried by David Chikodzi et al (2013), in the South-eastern parts of Zimbabwe, the summer temperatures have increased by an average of 2 degrees Celsius. Bohle et al (1994) cited in a journal by David Chikodzi argued that, an increase in average

temperatures by 2 degrees Celsius will likely cause a decrease in Zimbabwean wetlands from 9% to 2,5% and an increase by 4 degrees Celsius is projected to reduce the summer water-surplices zones to less 2%. Moreover the shifts in temperatures will have adverse impacts the rain-fed agriculture in Zimbabwe.

According to a survey conducted by Steven Jerie and Ndabaningi T (2011) in Manicaland Province, high temperatures loosely translates to a decline in yields because high temperatures encourage evapotranspiration, affecting plant growth by reducing the soil moisture that sustains plant growth. They asserted that, maximum temperatures in the country in recent years have a negative correlation due to the fact, during summer season an expected increase in temperature will result in poor yields. Thus the temperature regime in Manicaland as shown by the study is a clear indication of a general rise in maximum temperatures in the country. This is in unison with findings by Hulme and Sheard (1999) in their work entitled "Climate variability and Scenarios in Zimbabwe," that Zimbabwe is experiencing significant warming.

1.3 OCCURRENCE OF EXTREME EVENTS: DROUGHTS AND FLOODS IN ZIMBABWE (Trend and Frequency)

Climatologists around the world have measured climatic conditions (prevailing meteorological conditions over a long period of time) for many years and this has made it possible to define what is normal and extreme. Occurrence and recurrence of extreme weather conditions like droughts and flooding is a good maker of climate variability. According to Rungano M et al, (2013) climate variability is known to cause the occurrence of extreme weather events such as droughts and floods. A drought has been defined by FAO as a reduction in rainfall supply compared with a specific period FAO (2004). This reduction in rainfall will have implications on all activities that require rain water as a source of sustenance such as crop and livestock production. This had been evidenced in Zimbabwe whereby the trend and occurrence of droughts indicate that, they are fast becoming more frequent than ever before. Zimbabwe has been experiencing droughts every 10 years since 1982 and the incidence of occurrence has actually increased in the 21st century where almost every season have been characterised by dry spells across the country. Recurrence of droughts in Zimbabwe is an issue of concern because it is slowly but surely leading to severe water constraints in all corners of the county, for instance Murhpree observes that, flows in the Save River have decreased from 9.7 cubic metres per second in 1982 to 2.7 cubic metres per second in 2009, a 43% reduction.

According to Charity Manyeruke et al (2013) during the 60s, 70s and 80s, droughts recurred after every 10 years, however this trend has ceased due to climate variability. By the mid-90s, the frequencies of droughts and dry spells had increased to every 4-5 years and by the late 90s, the country began to witness alternating wet and dry years in every 3 years. He further Manyeruke (2013) further asserts that, since the 2000, the country's situation in terms of occurrence of extreme events has worsened as droughts have become more successive from

2002/2003, 2004/2005, until 2007/2008. The successive occurrence of these droughts affected food production significantly since the government had not adopted effective adaptation measures to mitigate the impact of climate variability in the country.

The table below was adopted in a journal by Rungano Mapfugautsi and Constantine Munhande (2013) and is showing the top ten natural risks in Zimbabwe for the period 1980 to 2010, where droughts happens to be the dominant climatic risk in terms of number of people affected.

Table 1.1: Top 10 Natural Disasters in Zimbabwe: 1982 to 2010.

	Disaster	***Year***	***Total People Affected***
1	Drought	1982	700 000
2	Drought	1992	5 000 000
3	Epidemic	1996	500 000
4	Drought	2002	6 000 000
5	Flood	2000	266 000
6	Drought	2005	55 000
7	Flood	2001	30 000
8	Drought	2008	2 100 000
9	Epidemic	2008	98 349
10	Drought	2010	1 680 000

Source: adapted from: The OFDA/CRED International Disaster Database (OFDA/CRED, 2012)

The table clearly indicates that, prior to the new millennia; droughts as observed in the foregone literature occurred at a 10 year interval (frequency) that is 1982, 1992 and 2002. It is therefore a clear indication that, agricultural planning was easy because the farmers and the agromet service providers could easily predict or forecast into the weather trends. The

predictability of the drought trend also meant that, policy makers would suggest on the seasons they could export the agricultural surplus especially maize which is the staple food for the Country and seasons that required storage to ensure food security for the country. The table also provides ample evidence that, since 2002 drought, there has been an increased frequency in the occurrence of droughts, the trend has become successive and one can no longer predict when the next drought can occur.

This has had implications on the wider economy as it reduced crop yields and lead to unsustainable marginal lands for livestock. In addition to causing extensive crop failures, the increase in drought frequency had resulted in livestock deaths, which is detrimental to longer-term development as livestock is a key to livelihoods in communal areas in Zimbabwe. This is mainly because animals are difficult and expensive to replace FAO (2008). Apart from that, the diagram clearly justifies the choice of period due to the fact that, it is in the new Millennia that the trends in the occurrence of droughts become distorted, now the trend become so unpredictable as compared to the yester decades when droughts in Zimbabwe were recorded once after ten years. Evidence above is therefore highlighting that oscillations in weather conditions or deviations from the previous climatic course became prominent in the New Millennium.

1.4 SHIFTS IN NATURAL AGRICULTURAL ECOLOGICAL ZONES AS A RESULT OF CLIMATE VARIATIONS.

Agro-ecological zones are land areas representing unique combinations of homogenous agro-climate, ecology, soil units and agricultural activities (FAO, 1978). Several techniques have been employed to achieve this, but usually climate takes an overriding influence due to the fact that it is subject to change. In Zimbabwe, earlier work by Vincent and Thomas, (1960) divided the country into five agro-ecological zones, with best agricultural suitability being highest in Region 1 and least in Region 5; however the increased variability of rainfall has possibly affected the agro-ecological region boundaries. The spatial distribution of average rainfall was the basis of this classification David Chikodzi et al 2013. This section on AEZ is going to be influenced by the works by various scholars like of Vincent and Thomas (1960), Kainamura (2000) and Mugandani (2009). The study is anchored on that, climate variability has resulted in shifts in weather patterns which has ended up in redundancy of the ecological boundaries that were established in 1960s by Vincent and Thomas.

The agro-ecological regions generated by Vincent and Thomas in 1960 have been used in the country for more than 50 years it can be clearly said that, there continued use can be misleading that climate is stable. This is mainly due to the fact, research by various climatologist and environmentalist points to the contrary that climate is stable. Mugandani et al (2012) cited an example in his journal by Makarau (1999) who noted an increased variability in rainfall rain days and temperatures in Zimbabwe, these are possible pointers of climate variability in the country. Furthermore, Mugandani cited Low (2005) who is of the opinion that, most parts of the country have become warmer and drier. The above scholars are concurring that climate is not stable in the country, henceforth there is need to re-classify agro-ecological regions because there continued use can be equated to the idea that there are no variations in weather conditions.

David Chikodzi et al (2013) asserted that, several factors contributed to the redundancy in the agro-ecological zonation by Vincent and Thomas, among these factors include the idea that, they did not consider effective rainfall, did not consider anomalies in length of growing season for individual stations in Zimbabwe, and used a database with very few data and less developed tools. Technological change has brought new methods and techniques, better updated and managed databases, hence there is need to reclassify these zones. Due to the effects of climate change and variability, Zimbabwe now has more hot days and fewer cold days as compared to the 1960s when Vincent and Thomas did their agro-ecological zonation of Zimbabwe. Thus it can be seen that, reclassification has been enhanced by the availability of sophisticated machines unlike during the 60s when the zonation was carried out.

Mugandani (2009) reclassified agro-ecological regions of Zimbabwe at a scale of 1: 1 000 000. The new regions differed from the ones previously produced by Vincent and Thomas (1960). His work took a holistic approach in which most of the factors limiting land productivity were taken into account. The research however did not look at agricultural production trends and types in the new agro-ecological regions to compare them with the previous ones of Vincent and Thomas (1960). Dr Priscah Mugabe, a Deputy Director of the Institute of Environmental Studies at University of Zimbabwe argued that, there have been noticeable shifts in the onset, of the rainfall, increased frequency of heavy rainfall events, more low rainfall years increased proportion of tropical cyclones, mid-term dry spell are becoming more and more frequent and intense. She singled out shifts in natural regions using data collected from Chinhoyi and Chibhero weather stations and other surroundings which formerly under region 2 and are now classified under region 3. She asserted that, the AEZ I has been reduced, while natural region II has been pushed further east and III has shifted slightly upwards with Kwekwe and surrounding are now classified under natural region IV.

The new Natural Region II

According to Mugandani R et al (2012) the area covered 29,658.62 km2 translating to about 7.6% of the whole country. In the previous classification, the area covered 15% (58,536 km2) of the country. The results indicate that the NR has actually decreased by 49%. In the new classification, Mhondoro has moved from NR II to III. There is also a new narrow belt extending from Nyanga southwards, which is now part of NR II and appears to demarcate NR I from other regions. The shape of this region has also changed as part of it has been intruded by NR III. Farmers in this NR grow maize, tobacco, cotton and wheat; in addition to intensive livestock production. The new NR II is also characterised by mean maximum temperature range of 19-23 ºC, mean minimum temperature range of 10-13 ºC and mean annual temperature range of 16-19 ºC Mugandani et al (2012).

The new Natural Region III

Mugandani et al went on further to reclassify region 3 and came out with these results. The area covers 62,829 km2 comprising of 16.1% of the whole country. In the previous classification the area covered 72, 975 km2 and this equates to 18.7% of the whole country and in this new classification, NR III has been encroached by NR IV. The area now occupied by the NR has decreased by 13.9%. Farmers in this NR mainly concentrate on maize, tobacco, cotton, wheat and cattle ranching. Other characteristics of the new NR include mean maximum temperature range of 23-26 ºC; mean minimum temperature range of 11- 15 ºC and mean annual temperature range of 18- 22 ºC.

The new Natural Region IV

The area covers 155, 707 km2 which translates to 39.9 % of the whole country, in the previous classification, the area occupied about 37.8% of the country. Other characteristics

of this NR are, mean minimum temperature range of 11- 20 ºC; mean maximum temperature range of 19-26 ºC and a mean annual temperature range of 18-24 ºC. The NR has increased by 5.6% as a result of the greater part of Gweru being downgraded from NR III to IV. However, this did not result in a significant increase since the Hwange area has been downgraded to NR V, mainly because of the new classification criteria since the greater part of that area has rag soils. Natural Region IV is an extensive livestock production area and crops such as sorghum and millet rapoko thrives in the area. Mugandani et al (2012).

The new Natural Region V

Finally Mugandani also provides results about the last region which is region 5. The new Natural Region V covers about 126, 829 km2 which is equivalent to about 32.5% of the whole country, in the previous classification, the NR constituted 26.7% of Zimbabwe. In the southern part of the country, the NR has extended northwards, other parameters that describe this NR are mean annual temperature range of 21-25 ºC; mean maximum temperature range of 26-32 ºC and mean minimum temperature range of 14-18 ºC. Henceforth there has been an expansion of the arid conditions into regions that were once semi-arid in nature as a result of serious and more frequent rainfall deviations from the mean annuals that have resulted in difficulties in scheduling the best for crop production. Therefore one can deduce that, from the above evidence, agro-ecological zonation has become less effective as a planning tool for viable and sustainable agricultural production in Zimbabwe.

1.5 AGRICULTURE IN THE CONTEXT OF CLIMATE VARIABILITY IN ZIMBABWE

According to the World Meteorological Organisation (WMO) report on Zimbabwe (2007) rainfall is by far the most important variable that affects crop production. The agricultural system in the country is particularly vulnerable to climate variability due to its over-reliance on rainfall which has become very much unpredictable and unreliable in the past decade (2000-2010). This is mainly Zimbabwe‘s agricultural sector currently represents the largest force driving the country’s economy. Agriculture is mainly dependant on climatic conditions and this makes it extremely vulnerable to climate change. In Zimbabwe, climate is characterised by a history of rainfall fluctuations of varying lengths and intensities, as a result of these fluctuations, there is now marked deviations in precipitation trends in the rest of the country, from the mean rainfall amounts between the periods 2000 to 2010. This is a clear indication that rainfall patterns are changing across the country as a result of climate variability affecting agriculture which is the backbone of Zimbabwe's economy providing for over 50% of the Gross Domestic Product, Steven Jerie and Ndabaningi .T (2011).

According to a country report by Tigere Chagutah (2010), the reliance of the vast majority of Zimbabweans on rain-fed agriculture and the sensitivity of major sectors of the economy to the climate make Zimbabwe particularly susceptible to climate variability and change. Historically, agriculture has been the bedrock of Zimbabwe’s export revenue (known as the bread basket of Africa), contributing 51% of export earnings in 2000 Tigere (2010). Climatic variability in the country raises concerns regarding Zimbabwe’s strong dependence on agriculture for economic development due to the fact that, so much of national agricultural production is based on rainfall, therefore the country’s output in yields is directly influenced by weather patterns. It is important to note that, as a result of climate variability which is affecting even natural regions I, II and III which used to sustain agriculture in the country,

Zimbabwe in recent years has been struggling to reach a point of self-sufficiency. On the other hand, an underdeveloped subsistence livestock sector and declining crop yield levels threatens the livelihood of the majority of Zimbabweans.

Zimbabwe's agriculture is heavily dependent on natural rainfall (Burroughs, 2001). In the communal areas of Zimbabwe, agriculture is largely controlled by rainfall conditions. In these areas most elements of climate, particularly temperatures, are very uniform both over place and time, but rainfall is exceptionally variable Ndabaningi T (2011). Its variability especially in summer is a major determinant of crop output per unit area particularly in the communal areas where farmers dependent on it for their survival. Studies undertaken in Australia further support the assentation that a strong connection exists between yields and rainfall variability. Thus the study of climate variability is significant in the context of agricultural production and climate change Steven Jerie and Ndabangani (2011). The greatest challenge facing developing countries today is improving agricultural production to eliminate hunger and poverty (Nhemachena, 2003; Parry, 1978; Parry, 1981; Youdeowe, Ezdina and Onazi, 1986). The importance of precipitation to the Zimbabwean economy is well known, there is no branch of the economy that is not affected either directly or indirectly by this factor (Battalov, 1971). As such, efforts to better understand the impacts of climate on agriculture are important where development and poverty alleviation are concerned. According to the World Meteorological Organisation (WMO) report on Zimbabwe (2007) rainfall is by far the most important variable that affects crop production. Although there are different results from different studies, most assessments indicate that climate variability would have negative effects on agriculture.

The past decade has seen an increase in food and nutrition insecurity at household and national levels in the country, which has actually emanated from reduced productivity and production of maize crops due to climate variability and other social-political events that

were unfolding in the country. It is important to note that despite other factors that have affected agriculture in Zimbabwe, such as agrarian land reforms, climate variability has played a pivotal role in destabilising food production in the country. Ample evidence of the above sentiments was clearly shown during the 2011/2012 season whereby the country was forced to import over 50% of its maize requirements (The Zimbabwean). In summation, climate variability has posed a grave threat to the country's ability to ensure food security to its people.

1.6 CONCLUSION

Studies have proved it unequivocal that climate variability is among the greatest challenges facing mankind in the 21st century. The chapter was highlighting the fact that, Zimbabwe's weather conditions have decreased in terms of reliability and predictability due to climate variability and this has seriously impacted on agricultural planning. This final segment of the chapter provides ample evidence that, the Regions have become redundant and can therefore not provide the basis for sustainable agricultural planning and preparation as was done before.

CHAPTER 2: IMPACT OF CLIMATE VARIABILITY ON SMALLHOLDER FARMERS IN MAKONI DISTRICT, WARD 9

2.1 INTRODUCTION

This chapter is an indication of climate variability impacts on smallholder farmers in Makoni District and this will be accomplished through presentation of data that was gathered in the field. To gain full appreciation of the problem, the data collection exercise zeroed down to Ward 9 in Makoni District which lies in Natural Ecological Region three. The results of the data collected will be presented both qualitatively and quantitatively. Presentation will follow the sequence of the questionnaire and interview guides, it will start by presenting data on section B of the questionnaire on Farmer perceptions which covers issues on awareness and observations (local experiences) on climate variability by smallholder farmers and interviewed key informants thus the data from farmer perceptions and key informants will be analysed simultaneously. The section will highlight the observed rainfall variations like onsets and cessation, distribution and deviations of the amount and move to temperature variations. The chapter will then move on to section c and analyse the data gathered on the impacts of climate variability on crop production and then conclude with presenting information gathered on livestock production in the area.

2.2 FARMER PERCEPTIONS ON CLIMATE VARIABILITY IN WARD 9

Perceptions may be regarded as a way of interpreting something and in this case, these are observations by smallholder farmers based on eye witnessing (natural senses) and also based on hearing from the elders who always find themselves comparing today's weather conditions with the experiences of yester years. In presenting data on the perceptions farmers on climate variability, the researcher will also put across data from the stakeholders that will be concurring with farmer perceptions due to the fact that, Stakeholders using machines and farmers using natural senses, they all echoed the same sentiments about climate variability in the area of study.

Farmers were asked on how weather conditions have deviated from the expected course over the years, what weather was like during the past decades as compared to the New Millennia (2000-2012). The majority rated their knowledge on climate variability in their Ward as excellent due to the fact that more than 80% of the respondents had more than 20 years staying in Nyahava Resettlement area or Ward 9.

Table 2.1: **Knowledge of Smallholder farmer on Climate Variability**

Responses	**No of Responses**	**%**
High	2	7%
Very High	2	7%
Excellent	25	86%

2.3.1 Rainfall Variability: Local Experiences

The farmers revealed various aspects on rainfall variability which they highlighted have impacted strongly on their crop and livestock production. They reported shifts in the onset, cessation of the summer season, variations in the length of the summer season, distribution both spatial and poor distribution within the season (months) of rainfall and also noticed increased number of seasons without enough rainfall. As they were reporting, they were giving reference to past years however they could not produce actual figures to show increase or decrease in trends because perceptions are based on natural senses therefore they do have records. Thus the data on farmer perceptions will be presented **simultaneously** with the findings from Key Informants, mainly from the Meteorological Services Department on this section.

2.3.1.1 Onsets and Cessation of summer seasons

According to the Meteorological Services Department of Zimbabwe, onset of the season or a start of the rain season is attained when a place receives 20mm in 1 or 2 days and there is dry spell of more than 10 days expected in the following 30 days. It is important also to look at the rainfall trends that used to prevail in Zimbabwe. According to the information obtained from Met Services Department, the main rain season in the county starts in mid-November to mid-May and this was in tandem with the farmer perceptions when they were reporting noticed shifts in seasons in the recent years.

The farmers reported that, over the past decade, the onset of the rainy season had shifted. The majority who responded to questionnaires and interviewed to further their interest clearly indicated that, prior to the new millennia, their farming activities usually started around the 20th of October however in recent years it is no longer constant as it was. They clearly asserted that, during the yester years, most of them seemed to have compared the 90s with

recent years, they highlighted that, the rainfalls were constant after the onset of the growing season that is mid-November but the rainfall patterns are now erratic which is to say that, they are not even and regular. Nowadays, it is very rare to start farming and finish without the ground going dry (deterioration in soil moisture) due to dry spell they postulated. Most of the farmers indicated that, to quote the direct expressions from the majority of interviewed farmers, *"mazuva ano zvazvekuti rimei mombosendeka magejo pasi pambooma,"* which is to say that, they cultivate the fields and the ground go dry before they finished tilling on their fields. The farmers echoed the same sentiments that, they used to start their farming activities around the 15th of November in the previous years. They clearly postulated that, now the summer is coming either late or early and this has resulted in failure to predict about the summer and made it difficult for planning purposes. A significant number of interviewed farmers indicated that, in the recent years the area is now receiving effective rainfall to start farming activities early December or even late. The effects of late onset are most felt in some years when the cessation came as early as beginning of March. This is clear indication of poor distribution of rainfall within the season and this had largely impacted on all spheres of smallholder farmers in Makoni District.

Farmers did not only report variations of the onset, they also indicated late, early and abrupt shifts on the cessation of the crop growing season. One interviewed farmer said that, "seasons have become more unpredictable and unreliable with rains ending more abruptly and early and sometimes late." The impact of these variations on cessation whether early, late or abrupt will be explained on the section on the impact of climate variability on crop and livestock production. The farmer perceptions were supported by the figures the researcher got from the Extension Officer from AGRITEX department within the Ministry of Agriculture pertaining onset and cessation of summer session in the area. The majority of farmers during interviews after they have completed questionnaires were further probed to explore information on

specific seasons that required memorising what had happened in the yester seasons. 21% of the interviewed farmers managed to memorise about the early and abrupt cessation of 2005/2006 and 2009/2010 seasons. They indicated that, the cessations during the mentioned seasons were sudden and unexpected or not reasonable with most of the crops left immature. This was in tandem with interview respondents by the Key informants from the AGRITEX and Met Services who concurred that, some seasons are ending abruptly yet it is supposed to be gradual as was used to be experienced in 90s. They also recorded abrupt cessations in the indicated seasons by smallholder farmers with sharp and sudden decline. The table below are figures obtained from the AGRITEX indicating rainfall onsets and cessations of 1997/98 and 1998/99 seasons compared to the seasons ranging from 2000 to 2010.

Table 2.2 Rainfall Onsets and Cessations, Millimetres, 1997/98 -2000/2010

Year	Months of Onsets, mm		Months of Cessation, mm	
1997/98	15 November	25mm	20 March	65mm
1998/99	17 November	35,5mm	18 March	37,7mm
1999/00	2 November	22mm	25 March	22,9mm
2000/01	29 October	63mm	12 April	45mm
2001/02	10 October	34,2mm	30 March	23,4mm
2002/03	23 November	25mm	15 April	23mm
2003/04	12 December	67,2mm	13 March	45,4mm
2004/05	12 October	23mm	23 March	23mm
2005/06	26 October	22,8mm	23April	56,4mm
2006/07	12 December	45,3mm	23 March	43mm
2007/08	17 October	23,1mm	29 April	34mm
2008/09	13 December	27mm	15March	56mm
2009/10	05 December	45,5mm	23 March	34,5mm

Source: AGRITEX

The table is showing clearly the variability of onsets and cessations of rainfall and serves as evidence to above farmer perceptions that are variations on the onsets and cessations of the summer season. The table is showing that, there seasons are no longer predictable and reliable and this has largely affected the yields.

2.3.1.2 Rainfall Distribution

Farmers also reported that since the turn of the new millennium, effective rains now fell within one month therefore there is reduced efficacy of rainfall which means the ability to produce the intended results. They highlighted that, mostly effective rainfall is being recorded in the month of December and early January and the rest of the season is now comprised of successive and prolonged hot and dry spells. The farmers noted that, during the 90s, rainfall distribution was even and normal and they could plan their agricultural activities properly and effectively, knowing to expect significant dry and wet spells. The table below shows monthly rainfall distribution in Makoni District from 2000/01 season up until the 2008/09 seasons.

Table 2.3 Rainfall Distribution within the rainy season (mm)

Season	Oct	Nov	Dec	Jan	Feb	Mar	Total
2000/1	76.2	206.7	102	98	54.6	65.5	603
2001/2	13.7	23.6	24	43	19	11.7	135
2002/3	67	205	245	76	38	82	713
2003/4	17	189.6	154.9	91	28	0.7	481.2
2004/5	62	462.8	239.7	51.9	130.8	1.7	948.9
2005/6	104.4	86.8	85.5	94.8	23.4	70.9	465.8
2006/7	59	194.0	148.4	128.1	40.6	15.7	585.8
2007/8	42	99.3	123.2	45.1	22.5	11.6	343.7
2008/9	178.7	362.9	239.9	37.8	7.4	0	826.7

Source: Meteorological Services Department.

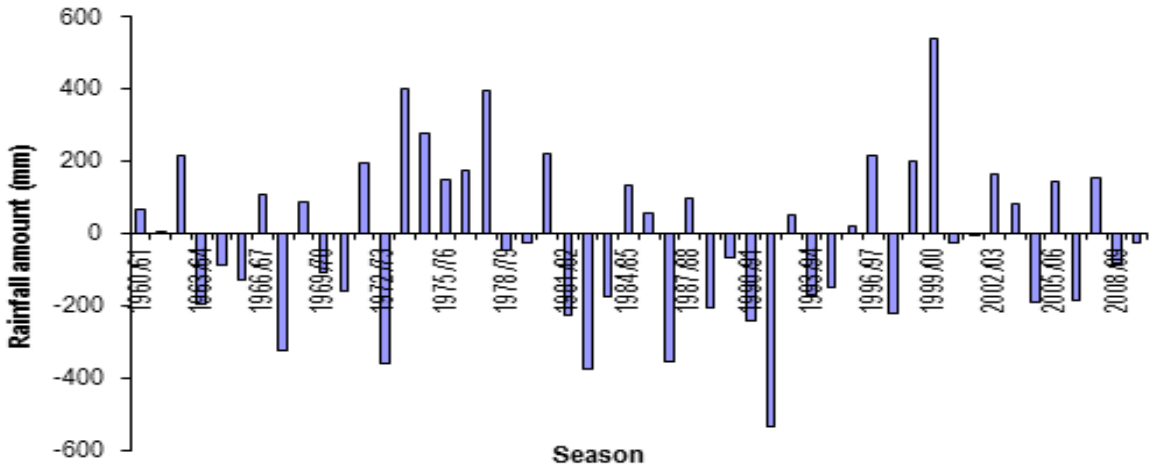
The table above corroborate or confirms about the farmer perceptions on rainfall distribution within the season that, the rainfall is no longer evenly distributed; there is tendency of receiving effective rainfall within two months mostly during the month of December and the rest of the season is characterised by hot and dry spells a major determinant of inadequate rainfall.

During the interview session with many farmers they also noted increases in spatial rainfall distribution variations which mean variations relating to space. Another prominent farmer who was interviewed argued that, some places are receiving evenly distributed rainfall, whilst their neighbouring areas receive erratic rainfall and this was unheard in the past years. The farmers were asked the reasons and 85% indicated that, those villages that are located close hills sometimes tends to receive rainfall without spreading evenly to other areas and the remaining 15% argued along the line of culture and tradition as the reason to this uneven rainfall spatial distribution or rather climatic variations. The main reason cited was manifestation of moral or cultural decline or moral decadence and rejection of cultural belief. The key informants (village elders) interviewed emotionally argued that people have rejected their own cultural and religious practises and the following are some of the expressions from farmers "…. We have abandoned our ancestors and we are now following modern world so much that we no longer climb the Nyamazi hill where there is a shrine to pray for good rainy season from our ancestors", and therefore echoed the sentiments that, climate variability is a punishment from ancestors. Whilst the 85% were of the view that climate variability emanates from natural climatic processes and cannot be influenced by any other factors and they therefore nullified the traditional factors which the majority of the elderly population were very emotional about.

2.3.1.3 Deviations in Rainfall Amounts

Before 1990, most areas used to receive adequate rainfall for crop production, and the temperatures were normal however, from the early 1990s, farmers started to observe changes in rainfall and temperatures. Rainfall has continued to change in amounts and distribution farmers reported a decline in the amounts of rainfall received during seasons as compared to yester years. The majority of the farmers compared the 90s with the new millennia seasons and argued that there is drastic change in the annual amounts. This was in tandem with the information obtained from the Met Services Department who also echoed the same sentiments about annual rainfall amounts in the District at large. The graph below shows rainfall deviation from the normal amounts in Makoni District from the 1960/61 season until 2000/10 seasons. It also corroborate with perceived deviations in amounts by smallholder farmers in Ward 9 that is progressive decrease in the amount of rainfall received in the district.

Figure 2.1: Deviation of rainfall amounts from the normal (mm) in Makoni District



Source: Zimbabwe Meteorological Services Department

2.3 2 Deviations in Seasonal Temperatures

Unanimous perception existed amongst various farmers that, there is a general increase in annual temperature ranges during the last decade till present moments. The general rise in temperatures has already brought enormous variations in weather patterns and untold suffering to the smallholder farmers in the District. Unanimous perception also exists in that, there is general rise in temperature in the winter season, and they noted that, the winter season is no longer as cold as it used to be in the past decades. There was a general concurrence between the stakeholder community key informants and farmer perception on the variations in temperatures in recent years. Increases in temperature have resulted in the recurrence of droughts at very short intervals as compared to the very past experience. Some prominent farmers concurred that "…..in our life time, it was unheard of to have 2-3 poor rainfall seasons in a row, occurring constantly or continuously. Nowadays, these poor seasons have become more and more pronounced, occurring on a regular basis usually accompanied by high temperatures especially during the months of October and January."

The above expressions were also in tandem with the information from the AGRITEX that, there is an increased frequency in the occurrence of droughts and this instant variation in drought occurrence was recorded in the new millennia citing the seasons 2001/02, 2004/05 2005/06, 2008/09 as compared with the 1981/82, 1991/92 then 200/02 seasons were droughts were recorded at a ten year interval. As a result of recurrence of droughts and prolonged dry spells, farmers reported a severe dying up of several wetlands, river streams and decline in discharge of river Chinyika and Nyan'ombe which pass through the District. The Elderly community indicated extinction of many grass species associated with wetlands as a result of these increases in temperatures that have resulted in massive losses in water storages both surface storage and underground storage.

2.4 IMPACT OF CLIMATIC VARIATIONS ON SMALLHOLDER FARMERS

Farmers indicated that lack of capital to buy inputs and food, shortage of draught power, low livestock prices and pests and diseases for crops and livestock among other stressors are linked to climate variability. Essentially among many other constraints that confront farmers, climate variability remains the most critical factor that has exacerbated severe crop and livestock failures. This section combines data obtained from the smallholder farmers and also from the key informants who included the Prominent Smallholder Farmers of Ward 9 and Extension Officers from Department of Livestock Production and Development and also from Department of crop Production.

2.4.1 IMPACT ON CROP PRODUCTION

The crops that are grown in the area are maize, ground nuts, round nuts and sun flower but maize is most grown crop in the area. Local agricultural extension (Agritex) officers noted that crop failures in the area have been attributed to variations in rainfall patterns. The farmers reported that, the decline in crop production has come as a result of hardships in predicting of the rain season. The farmers fully agreed that crop production in recent years has declined as a result of variations on the onset and cessation of the summer season, they reported that, variations on the onset and cessation have caused confusion to farmers to an extend that they no longer know when to expect the rainfall and have affected planning agricultural activities altogether. The farmers posited that, they prepare their crop lands early by spreading their manure evenly in the fields which would have been deposited in the fields around the month of August. They argued that, early preparatory activities is done in anticipatory of the rain season to start the cropping season which have become mostly unpredictable making it difficult for them to plan to ensure maximum crop yields. On the issue of season's onset and cessation, these were some of the expressions by the majority of

the smallholder farmers "…..now we don't know when exactly to start the sowing processes, because nowadays successive hot dry spells have got a tendency of destroying the crops before they have matured.

Given that water availability is a key component to crop productivity and food security, erratic rainfall thus constrained the sustainability of agricultural activities. The farmers also underscored that, perpetual decline in rainfall and skyrocketing water shortages in the region poses serious implications on rain-fed agricultural activities. This is being made possible due to consecutive droughts, unreliable rainfall and successive hot and dry spells. The farmers perceived effective decrease in in the amount of discharge in the Rivers Chinyika and Nyan'ombe and as a result, farmers reported that, their gardening activities are severely undermined as they are undertaken along closer to the river channels.

The local Agricultural Extension Officer also confirmed that, crop pest have also become rampant as a result of the weather related variations highlighted by smallholder farmers. This clearly supports the argument by FAO (2008) that, Zimbabwe has been experiencing more frequent naturally induced disasters, such as floods, droughts and pests infections. The perceived weather variations mentioned in the last section like reduction in rainfall amounts and increases in temperatures provides good conditions for pests to multiply and therefore results in decreases in yields especially for maize which is the staple food for the study area and Zimbabwe at large. Majority of the smallholder farmers who were interviewed reported that, the increased risk of pest has also lead to increased need for use of chemical pesticides to control them, a situation that enhances production costs and also increases in environmental problems associated with the application of agrochemical use.

Answering the question that was comparing productivity before the new millennia (2000) and after, three prominent farmers who were identified through the aid of a local Extension

Officer had input in answering this part. They pointed out that, any problem that limits harvests is perceived as leading to bad season with weather related factors especially rainfall variations being the chief culprits. Using the experience they have, they rated seasons in relation to productivity as, 'bad, normal and good." A normal season was generally regarded as a season were the produce or yields are enough only for household consumption without any surplus for sales with normal amounts and fair/steady rainfall distribution throughout the season. Finally the key informants who were used by the researcher to gather crop productivity prior to the period of study considered good seasons to be seasons were crops grow very well and with enough maize for subsistence as well as surplus for sale. They argued that seasons are characterised by above normal rainfall amounts with a good distribution within different months and early onset and late cessation of the rainfall season.

The Prominent farmers had vivid memories on their productivity prior to 2000, all of them confirmed that the 1991/2 season resulted in devastating effects on the crops they all reported severe household food insecurity as a result of that drought. Apart from the 1991/2 season which the farmers rated as the worst year in memorising about crop productivity before 2000, the prominent smallholder farmers also reported of a bad season of 1996/7 though they all confirmed that it was not as worst as the 1991/2 season. They all agreed that, the seasons had an indelible or they all said they were unable to forget about the devastating effects of the bad seasons on crop production. The smallholder farmers posited that, during the 1990 to 1999 decade and before, seasons were regarded as "good", they could produce enough for subsistence and surplus to send to the markets as well as paying for their labour during the following seasons. Thus the key informants produced powerful feelings or strong, images in the mind that clearly justifies that, climate variability is an enemy of crop production.

One 56 year old prominent farmer a female explained that "….before 1999, maize and productivity for other crops like ground nuts and round nuts was reasonable as one could

harvest about 20 ox-carts of unshelled maize in two hectares but starting from 2000 onwards, things have totally changed, you can only get about 4 ox-carts of unshelled maize from the same two hectares…" This presents a productivity decline of about 80% within the period of 12 years which is major threat to food security at household and at national level since these smallholder farmers could no longer produce surplus to send to the Grain Marketing Board.

One of the Prominent farmer also echoed the same sentiments pertaining to productivity during the seasons before 1999 that,

> *Ndaisimbokohwa chibage chekuti ndaizadza matura ndoendesa chimwe GMB. Ndinoyeuka kuti ndaiendesa masaga 100 anova ivo matonnes mashanu and kunyangwe mugore 1992, nzara haina kundirova nekuti mudura mangu maive nechibage. Goho rangu raisvika mumwe mwaka unotevera chibage chirimo uye ndaishandisa goho kutsvaga vanhu vemaricho waiita basa mumunda mangu asi izvezvi hakuchina kuendesa kudura renyika ukatowana chinokwana kudya wototenda Mwari.*

This is a clear indication that smallholder farmers used to contribute significantly to food security in the country by sending surplus produces to the Grain Marketing Board. The existence of GMB Deports in various districts in Zimbabwe showed that decentralisation followed smallholder farmers around the country who used to contribute immensely to the Gross Domestic Product in our agro-based economy and failure as result of climate variability had eroded their well-being and sources of livelihoods. Therefore one can derive the conclusion from the above expressions by smallholder farmers that, climate variability is one of the major factors undermining crop production in Zimbabwe. One can regard it as the major culprit to decline in yields by smallholder farmers and stop nailing the whole blame on

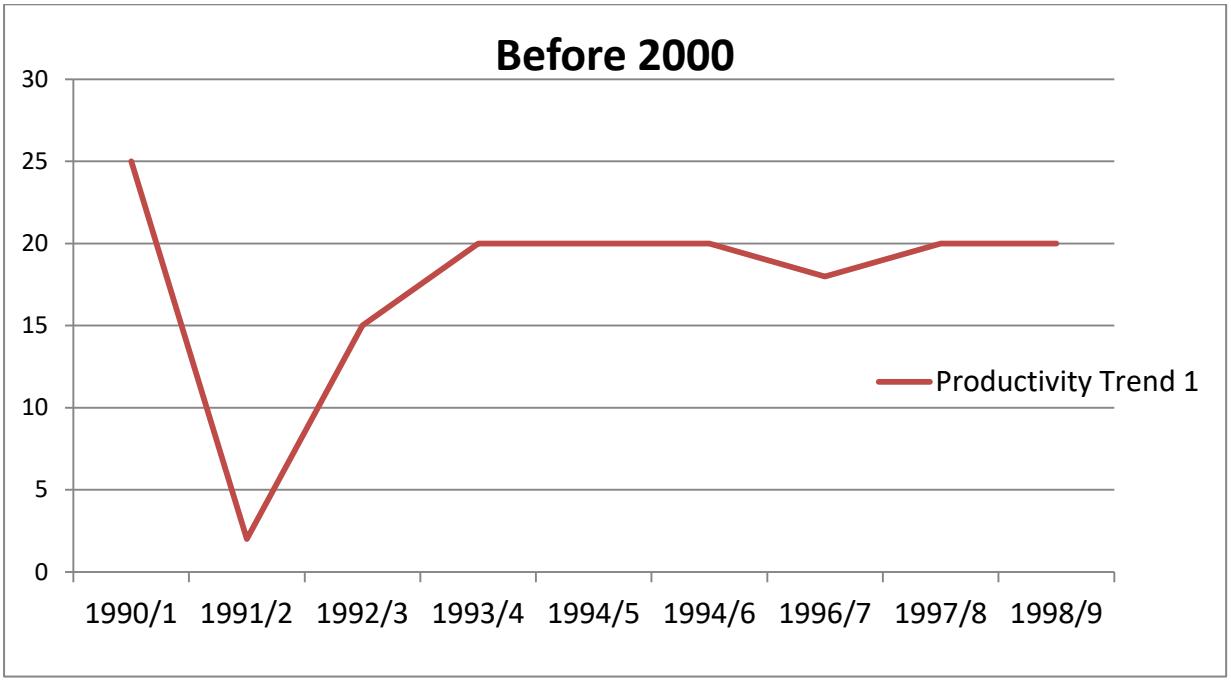
the failure of stakeholders to support the smallholders but rather notice that, perceived weather-related variations are the chief culprits to dramatic fall in crop productivity.

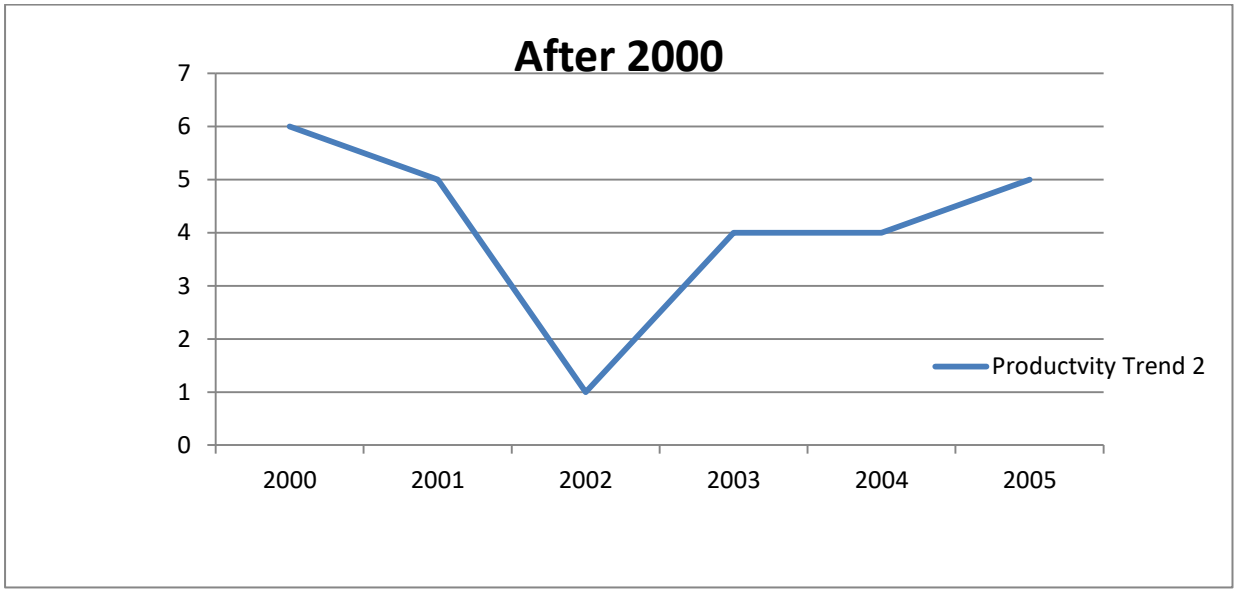
After the farmers have produced vigorous and lively memories about the productivity 1999 periods, they went on to compare it with recent seasons that is seasons in the new millennia until 2012. The farmers expressed that the period was characterised by "bad" and "normal" seasons as indicated above that normal seasons referred to seasons when they only produce enough for subsistence without any surplus to sale and pay for their labour force as they used to prior to 2000. In explaining the productivity during the new millennia, the prominent farmers argued that, the recurrence of droughts and prolonged hot and dry spells have severely curtailed or reduced the extend of quantity in yields. They expressed that especially for both ground and round nuts which used to thrive in the area, reduction in soil moisture which is a key determinant of plant life have resulted in failures in productivity of nuts.

In comparing the current seasons beginning from 2000, the farmers pointed out when they had last produced a surplus to send to the market (GMB), Mrs Nyamusa a 56 year old woman who was recorded during the interview postulated that, she had last produced such surplus in 1999. She had a vivid memory that she last send four tonnes and she exclaimed "that was then until now", in 2000 the cyclone Eline affected our crops, 20001/02 season there was a drought and it was bad year both for our livestock and crops. From there, the rainfalls have become erratic all of a sudden with irregular patterns, the distribution had also become very poor within the season and she also exclaimed that, "*chibage chakumboita sechaoma pakati pezhizha mvura yozouya pave paye*, uye ufunge zvako *mwanangu zviya zvokuti firidhi day hakuchina mwanangu, ndaisimborima zvaizivikanwa nedundu rose asi zvakapera*". The erratic weather conditions have resulted to massive decline in crop yields for all kind of crops that we grow in this area. The graphs below indicate the productivity trends before 2000 and

after 2000 as it was presented by the key farmers and other general smallholder farmers in Ward 9.

Figure 2.2: Crop Productivity Trends Before and After 2000.





The graphs are showing the number of ox-carts of unshelled maize obtained in two hectares, by the prominent smallholder farmers and other farmers before the new millennia and after. The first depicts the picture that, the farmer productivity ranges around 25 to 18, and as they

clearly postulated, they used to send surplus to the Grain Marketing Board. This was because before 2000, the area used to receive adequate rainfall for crop production and temperatures were normal. The sharp decline witnessed prior 2000 was as result of the 1991/92 season were every farmer prominent or not had vivid memories of the severe losses in productivity, most of them argued that "mugore iro takarasa mbeu." Then the second graph started with maize productivity of 6 ox-carts of unshelled maize from the previous 20 ox-carts obtained the previous year on the same hectares due to the cyclone Eline which they all said it severely eroded their produce. Then it was from the flood of 2000 to the drought of 2002 and since then, almost every season has been characterised by prolonged dry spells and recurrence of droughts. They all exclaimed that, before the new millennia droughts used to occur after 10 years, in 1981/28, 1991/29 then 2002 seasons but nowadays, the frequency has altogether changed, they are occurring any time. Therefore one can note that all farmers in spite of their wealth classes had been severely affected by climate variability as witnessed by the prominent farmers who had input in this section who can no longer produce surplus despite their ability and capacity to afford variety of inputs.

2.4.2 IMPACT OF CLIMATE VARIABILITY ON LIVESTOCK PRODUCTION

The section is based on the farmer perceptions as well as information gathered from Mr Makaza an Officer from the Department of Livestock Production and Development within the Department of AGRITEX in the broad ministry of Agriculture in Makoni District. The officer had great skill and knowledge in the field of livestock (expertise). He explained many factors that have been affected by climate variability with a negative bearing on livestock which include, seed formation and germination, grazing lands, diseases, issue of weight, water scarcity, climate variability and calving rate and also the issue of livestock mortality. Worth noting in presenting data in this section is that, the information provided by the key informant just like in the previous section corroborated or was a confirmation of perceptions by smallholder farmers regarding their livestock.

Most of the farmers in Ward 9 and Makoni at large keep cattle and goats and very few among them had a combination of cattle, goats and pigs. Out of the 29 respondents 26 of them that are 90% have a combination of cattle and goats whilst the remaining 10% have a combination of all and pigs. According to the observations made by the researcher, almost every household had a kraal which shows that cattle accounts for the majority of livestock in the area of study. They are mainly kept for draft power purposes and other purposes like paying bribe prices and milk.

With regard to grazing lands, the majority of smallholder farmers articulated that, the inadequate rainfalls have affected the quantity and quality of grass available. Grazing lands were explained in relation to water scarcity by majority of smallholder farmers with one elderly Key Informant posited that "…. certain grass species associated with wetlands have extinct as a result of inadequate rainfalls of which they provided important fodder for

livestock. This explains the above contention by the majority of respondents that, inadequate rainfall has affected quality of grazing.

Mr Makaza Livestock Officer linked inadequate grazing for livestock to limited germination of grass as a result of variations on the onset of seasons. He postulated that late onset of the summer season have severely undermined germination of grass seeds on grazing lands and on the contour ridges within individual yards. He went on to say that weather vagaries or erratic and unpredictable patterns have severely curtailed seed formation and as a result there is a general shortage in the grass for cattle grazing. Of all the livestock community, cattle happen to be the most vulnerable because they are strictly grazers unlike goats that are mainly browsers and partly grazers.

The smallholder farmers explained that, lately, the burden of livestock diseases has become a major issue due to increasing temperatures and reduced rainfalls. In regard to the issue of animal diseases Mr Makaza the key informant pertaining to livestock stressed the view that, climate variability has affected the distribution of tsetse flies which carries the sleeping sickness and cattle disease called *nagana* and the tick-borne livestock disease called East coast or corridor diseases. As a result one can easily notice that, livestock diseases present a great challenge to the smallholder farmers with limited resource endowments and cannot be able to take the necessary actions against the infections of these diseases.

In addition to crop failures, chronic hot and dry spells during the summer season are resulting in livestock deaths or mortality. He further asserted that “prolonged dry spells are detrimental to longer term agricultural development as livestock is a key livelihood activity in Zimbabwe’s communal areas as animals are difficult and expensive to replace. With the above combination at stake, one should be in a position to assess that smallholder farmers are at greater risk as a result of livestock deaths because is an important source of livelihood

income. Majority of the farmers explained that they use livestock income to pay for their children school fees, medical fees and to buy food. Therefore one can notice the value of livestock to smallholder farmers as a livelihood source and also notice the reason why smallholder farmers are so vulnerable to climate variability.

There was unanimity between the farmer perceptions and key informant that, poor rainfall distribution and occurrence of extreme weather conditions especially droughts has severely curtailed availability of drinking water for all livestock. When they were reporting about water scarcity as a result climate induced hazards, the smallholder farmers had vivid memories about the 1991/92 season when they reported severe livestock deaths. This was one of the emotional expressions that came from Mr Mukwekwerere regarding to water scarcity and livestock production during an interview,

> *...handikanganwe gore iro ra1992, mombe dzangu dzakatsakatira kumakomo, mombe dzangu 23 kurasikira kumakomo nekuti dzakange dzakutsvaga mafuro kumitunhu iri kure. Dzakasara dzose dzikapera kufa.*

This shows that when there is water scarcity, livestock tends to travel for distances in search for green pastures and drinking water.

The Livestock officer explained that, in recent years streams around the Ward and Makoni at large are drying up soon after the cessation of the summer season and same applies to rivers. The farmers also postulated that, Chinyika River which sustains all activities that requires water in Ward is no longer flowing all year round as it used to do during the early 90s. They reported that they stated by witnessing decreases in discharge and velocity until now the river is now an ephemeral course and is no longer sustaining their livestock. Farmers are now driving their livestock 5 to 6 Km to access water in Nyan'ombe River which is still perennial. As a result of water shortages, farmers explained their concern that, it is possible these days

for livestock to spend 2 to 3 days without drinking water because herdsman sometimes do not take them to the water sources and this has got severe implications on live-health.

The drying up of streams and river courses have affected livestock production in that, farmers have to walk their livestock long distances to drink water and this have resulted in reduced live-weight because the animals now spend most of their energy walking instead of gaining weight through grazing. Thus multiple of stressors, diseases, drying up of water sources and pastures due to droughts and prolonged hot and dry spells have negatively affected livestock production by smallholder farmers. The key informant on livestock production further explained the link that, after losing weight as a result of above explained combination of factors, livestock quality is also affected and as result he argued that the smallholder farmers will therefore fetch low market prices in the event that they sell their livestock all because of climate variability that have affected livestock quality.

The live-officer further explained the network of problems caused by climate variability on livestock by positing that, calving rate have also been severely curtailed by climate variability. Asked on what exactly is meant by calving rate the officer postulated that, it is the ability of cows to give birth per given time or period. The Informant stated that, under normal circumstances, given that the above explained factors (grazing lands, proximity of water sources etc.) are available it is possible for cows to give birth after every 1 and ½ years. His perception tallied with farmer perceptions that during the early 90s they used to fill their kraals with livestock for both goats and cattle because the calving rate was not prolonged as it is nowadays. They exclaimed that, now it is possible for your cow to spend 5 years without giving birth and they were really wondering what the cause is for such prolonged calving periods.

Apart from prolonging the calving rates, climate variability has also lead to dystocia which refers to difficulties in giving birth by cows which therefore has resulted in many still births. As a result the Live-officer explained that there has been high mortality of calves. One prominent farmer articulated that, "… I really wonder why because out of the 5 new born calves, you tend to lose 4 of them if not all sometimes, gone are the days when out every five new born calves you could only lose 1 if not all survive." This was in tandem with the information provided by the Officer that, climate variability has adversely affected livestock production due to deaths of many calves and many other factors explained before. The officer also explained deaths of calves in terms of low winning weight as a result of shortage of fodder for livestock and water. Finally and very interestingly the live-officer also explained low livestock productivity as result of low bull %. He posited that, climate variability have affected the breeding rates by reducing bull % as a result of livestock deaths. He asserted that, the ratio in cattle herds should be 1.4 that is 1 bull for 4 cows for effective breeding and to ensure high livestock productivity. Thus climate variability related livestock mortality has affected the bull to cow ratio thereby having a negative bearing on productivity.

Generally responses from Informants showed that, smallholder farmers in Makoni District are aware of climatic variations through their experience and there was a general consensus between the smallholder farmer perceptions with the agromet information obtained from the Zimbabwe Met Services Organisation. The study also observed concurrence between the farmers and the Livestock Production Officer as well as the Extension Officer (AGRITEX) that climate variability has caused remarkable reduction productivity. The study found out that, smallholder farmers may not be able to replace livestock because they need money to purchase them and their income sources are constrained by the nature of their livelihood activities such as farming which is sensitive to climatic related risks and under threat from climate variability. The above findings are consistent with scientific evidence that most of

Southern Africa is becoming increasing drier, with the distribution of rainfall within the seasons threatening agriculture and livelihood sustainability De Wit (2006) and Anderson J (2007).

The negative attitude manifested from smallholder farmers implies that, farmers may tend to under-invest in resources such as inputs as they are now very pessimistic and always plan with failures at the back of their minds. This is highly undesirable in agricultural production (the risk aversion and consequently the under-investment) as so much unpredictability hangs over everyone's heads in terms of how the seasons will perform. The researcher was made to be become afraid because the pessimistic attitude that have filled the smallholder farmers even those that were identified as prominent farmers has resulted to farmers perceiving higher risk than is actually existing within their localities. Grothman et al (2005) suggested that, most farmers have resigned themselves to fate and they believe they cannot do much to alter the environment. There is therefore need even for the poorest farmers to understand that, even with little resource they have, they can adapt and cope with impacts of climate variability.

The study also reveals that, the understanding of how smallholder farmers perceive climate risks is valuable to other stakeholders such as the Extension Service, providers and climate information providers as it can assist in the tailor-making their services to suit the farmers needs and support them to better cope and adapt with climate variability.

2.5 CONCLUSION

Generally, smallholder farmers are aware of climate variability mainly through observations of rainfall and temperature trends as they articulated oscillations in the onset and cessation of the summer season, increased variability in the intensity and distribution of rainfall and also shifts in the frequency of drought occurrence. There is also a general loss in livestock in the area which is rampant due to poor pastures as a result of inadequate rainfall. This also further compounded the vulnerability of smallholder farmers to poverty and other livelihood shocks. Moreover, it also emerged in the study that, production of the country's staple food, maize and other crops have been on a chronic decline. This has been largely attributed to decrease in precipitation coupled with increases in temperatures which have led to a nosedive in the agricultural production and deterioration of pastures for livestock. Conclusively, the smallholder farmers remains vulnerable to climate variability due to their over dependence on rain-fed agriculture and also given the fact that water availability remains a key component of agricultural productivity.

CHAPTER 3: CHALLENGES AND PROSPECTS FOR COMBATING CLIMATE VARIABILITY IN ZIMBABWE

3. I INTRODUCTION

The future of climate variability and smallholder farmers in Zimbabwe is based on adapting to the climatic variations in order to cushion the impacts of seasonal climatic variations on crop and livestock production. The chapter explores challenges and potential mechanisms that can be implemented in order to reduce the impact of climatic related risks on smallholder farmers in Makoni District and Zimbabwe at large. The research envisaged that, climate variability has posed threats to sustainable rural livelihoods in the country at large, therefore this chapter serves to explore coping strategies that can be implemented at all levels (household, community and national) to reduce the climatic related risks in the future and foster resilience among smallholder farmer communities in the country.

3.2 FUTURE INTIATIVES TO REDUCE THE RISKS OF CLIMATE VARIABILITY ON SMALLHOLDER FARMERS.

Adaptation is a broad concept informed by both the natural and the social sciences. In this thesis, it implies a process of adjustment to survive and ideally thrive in the face of climate variability. In the context of climate variability adaptation takes place through adjustments to reduce vulnerability or enhance resilience to the observed and expected climatic related risks. Adaptation of smallholder farmers in the area of study should involve changes in practises, perceptions and also functions in order to cushion the impacts of climate variability on their livelihoods. Worth noting is that, adaptation mechanisms may be initiated in a variety of scales, from institutionary driven policies to risk management decisions at individual households. A good example of a strategy undertaken at National level to reduce the impact of climate variability includes the launch of a drought tolerant maize variety such as

Sirdamaize 113 which holds tremendous potential in improving the livelihoods of smallholder farmers in the face of climate variability in Zimbabwe.

From the results discussed in the previous chapter, it is apparent for farmers to adapt to the prevailing weather conditions rather than to resign themselves to fate and believe that they cannot do anything to protect themselves from climatic related impacts. Although there strategies have not completely succeeded as highlighted by the research, they have developed a wide array of strategies in order to curb the impacts of climate variability. Farmers should not lose in trying to cushion the impacts of climate variability on their crop and livestock production. To start with, they should adopt measures like the mixed cropping mechanism in order to reduce to the effects of climate variability. The thinking is that, if one crop succumbs to weather vagaries, then other crops like sunflowers and beans will strive to grow in given weather conditions and therefore the method can hold water in trying to combat climatic related risks.

It is imperative for smallholder farmers to grow small crops like sorghum, millet and rapoko because they are panacea to climatic related risks like prolonged hot and dry spells and variations in the rainfall patterns and temperatures. Small grains are both adaptable to climatic variations as well as poor soils therefore the smallholder farmers in Zimbabwe should grow these small grains in order to enhance food security by boasting crop production. This finding has been corroborated by Chazovachii et al (2012) who asserted that, such crops are not only drought resistant but tend to be resistant also to pest and diseases that threatens crop productivity. Of note is the fact that, climate variability has caused extensive crop failure due to the fact that, climatic variations like increases temperatures and reduction in rainfall amounts has increased the incidence of the occurrence of pest and livestock diseases as was discussed in the foregone chapter. Henceforth, small grains can enhance food security in the face of climate variability in Zimbabwe.

Chazovachii further concurred, with the idea of growing of small grains by smallholder farmers in order to reduce their risk to climate variability by noting that, in 1996 the regional workshop on climate change promoted the production of small grains crops such as sorgum, pearl millet, finger millet, cowpeas, soya beans and ground nuts as panacea to counter the impacts of droughts recurrence as well as prolonged hot and dry spells due to poor rainfall distribution both within season and also spatial distribution that are as a result of climate variability. Thus one can argue that, crop diversification offers a pathway out of the poverty trap especially to smallholder farmers in Makoni and Zimbabwe at large. It is also important to note that, the aforementioned crops are also used for beer brewing which is quite crucial to smallholder farmers who commercially brew the traditional beer as a source of income as the raw material could be readily available. The practise of traditional beer brewing cannot be undermined as it constitutes essentially to off-farm activities or diversification of sources livelihoods by smallholder farmers which is another imperative means of combating climate variability in the country.

However the challenge that exists when it comes to production of small grains in order to diversify crops is that, they are neglected by majority of farmers basing their ignorance on the fact that, they are mainly grown by those who brew beer either to conduct traditional ceremonies like the rainmaking “maganzvo” or selling it to local villagers . As a result most people especially Christians have neglected small crops despite the push by local agencies especially AGRO-Germany a local NGO to gradually switch maize with small grains in the area of study. Majority of farmers perceive them as traditional therefore there exists a dire need for transformation in perceptions, processes and practises as indicated above in order to address this kind of ignorance by smallholder farmers in the country. The researcher saw a need for local agencies to educate people on the importance of small grains in combating the impacts of climate variability. Extension officers should strive to erase the misconception that

small grains are not cultural rather they are drought resistant crops which means that, they can endure long periods without rainfall and also requires less plant food as compared to maize. Henceforth they are essential in adapting to crop failures a direct consequence of climate variability. Therefore it is also imperative for the government and its implementing partners assist the smallholder farmers with inputs because it enables these crops to be grown by almost every farmer to cushion the risk of the crops being plundered by murmuring birds which is also a major drawback to small grains production.

There is also need for smallholder farmers in the country to adopt conservative farming methods to combat climate variability related risks (crop failures and livestock deaths). One of the methods that can a go a long way in reducing the effects of climate variability on crop production is zero tillage. The Officers from the local NGO who constituted the key informants sample concurred with the researcher when they posited that, the system of zero tillage an effective tool in soil conservation as it protects the top soil from being washed away by surface run-off and also wind. It is therefore apparent for Extension officers and local NGOs to encourage smallholder farmers not to excessively plough their fields because excessive tillage of the ground results in nutrients being percolated and as a result soil fertility is lost and also the water holding capacity is also negatively altered. Just to highlight scholarly or academic support base to the contention, Mutekwa (2009) concurred that, zero tillage is essential in adapting to climatic variations risks because it improves water storage in the soil therefore is essential in mitigating the impacts of droughts and dry spells. This therefore gives credence to Gukurume et al (2010) who also argued that, Conservative farming practises hold the promises for providing both a strategy for mitigating climate variability and also working an adaptive mechanism to cope with climate variability. As a result of the above highlighted advantages, zero tillage can be indeed a prospect or bears

likelihood in the future of enhancing agricultural production to smallholder farmers in the context of global climatic constraints or limitations.

However the researcher noted that, despite the aforementioned advantages of adopting the zero tillage technique in conserving the soil fertility and improving soil water retention or water holding capacity of soils the system has its setbacks. The system is labour intensive in nature therefore many farmers might not be wilful to practise the tillage system though they can acknowledge that it is a very essential and effective tool in increasing agricultural productivity. Against such a backdrop, Mutekwa concurred that the tillage conservative system is only for those farmers who are endowed with more livelihoods asserts as compared to those to those with limited resources. Therefore its labour intensiveness may presents challenges to its adoption in as much as it may seem to be a panacea in the fight against climate variability.

The researcher also encourages that; smallholder farmers should integrate scientific methods as well as indigenous knowledge systems in order to successfully mitigate the impact of climatic variability. This is mainly due to the fact that, IKS has been extremely useful in adaptation and mitigating the weather related risks. This has been archived through meticulous or very careful study and observations on plant and animal species, for example people could predict the likelihood of a drought by examining on certain wild fruits like "*hute*" and also studying the behaviour of birds like "*mafudzamombe"* and so many others basing on experience that have been accumulated over years and transmitted from one generation to another.

One of the Indigenous Knowledge techniques that the study recommends to be integrated with scientific techniques is mulching. The process of mulching can be an effective strategy in cushioning the impacts of poor rainfall distribution within seasons and variations in rainfall

amounts and patterns as well as increases in temperatures. The process of mulching involves the spread of crop residue, dry leaves, grass and other dead plants on the planted fields. The process of mulching can go a long way in reducing the direct impact of raindrop on fragile top soils by helping the water to seep into the soil thereby reducing surface runoff and washing away of the fertile top soil. Therefore it is important to note that, triangulation of IKS and Scientific methods in adapting to the impacts of climate variability can yield remarkable results with regard to combating climatic related risks. Furthermore mulching is quite recommendable in the face of prolonged dry spells and recurrence of droughts because it reduces evaporation of the water from the fields or it protects the soil moisture that sustains plant growth from evaporating. However the challenge in integrating the two sciences is that, climate variability has also affected the reliability of IKS as an adaptive mechanism to the impacts of climate variability.

It is worth noting that, in response to shortening of the growing season, that is as a result of variations on the onset and cessation of summer seasons, farmers should be conscious about timing, this can achieved through the early preparation of land well before the onset of rain, planting soon after effective rains fell, wedding at appropriate time and intervals and also correct timing on the application of fertilisers. Ramphal Sillah (2011) also supported this idea when he posited that, the usual scenario in most rural households has been that, the land preparation starts only after the onset of effective rains however in the face of climate variability which has resulted in shortened rainfall seasons, the farmers should commence there preparatory activities well before the effective rain. Hobbs (2007) also corroborated the above valid claim when he posited that, the end result has been that, farmers begin to race against time so as to beat the advent of full scale rains which leads to poor execution of operations which is equivalent to poor workmanship. Therefore one can note that, poor timing results low productivity therefore there is need for shifts in processes and practises by

small scale farmers in order to resist the potential threats of climate variability on crop production.

Furthermore, just like in the issue of crop diversification, it is advisable for smallholder farmers to diversify their livestock production by rearing small livestock because just like small grains, they are more adaptive to drier conditions. Diversification of livestock is essential to reduce the impact posed by climate variability on livestock production as was highlighted in the previous chapter. Cattle production is mainly limited by the shortage of sustainable grazing grass and this with a combination of many other factors had resulted to shrinkage on cattle herds. Therefore it is of vital importance for smallholder farmers not to wholly rely on cattle rearing but should also rear donkeys, goats, pigs and other small livestock. The risk of relying on cattle production alone as a source of both draught power and income is that, they are too sensitive to climatic related risks like water shortages and diseases the major reason being that, cattle is strictly a grazer unlike animals like goats, they survive in an hostile environment of limited grass because it is both a grazer and mainly browser. Therefore one can note that, grass is prone to destruction by weather vagaries as compared to shrubs that mostly sustain life for small livestock. Thus smallholder farmers are recommended to keep small livestock because like small grains they easily adapt to drier conditions making them ideal for adapting to the impacts of climate variability.

Apart from diversifying their livestock herds, it is also quite imperative for smallholder farmers to store crop residues '*mashanga/magonje*" as livestock fodder after the growing season. This is quite an intelligent recommendation because during the dry season, livestock (cattle) usually struggles to find sustainable pastures and it is during that season when majority of livestock deaths are experienced therefore smallholder with stores of crop residue will supplement unsustainable marginal lands during dry seasons with their locally available fodder. Those smallholder farmers that can afford animal salt animal salt will then sprinkle it

on the crop residues and making the fodder to be more nutritious and appetising to livestock. Thus one can note that, this mechanism can go a long way in managing the problem of unsustainable grazing lands a direct consequence of seasonal weather variations.

The researcher noted that, the capacity and ability of smallholder farmers to effectively mitigate and adapt to the challenges posed by weather vagaries can be undermined many factors which includes the lack of scientific information to integrate with their IKS, popular disincentive to grow small grains and small livestock and lack of incomes to buy inputs. Thus the study recommends the government, policy makers and researchers to become increasingly closer to grassroots farmers in order to cushion the problem of food insecurity.

At National level, there exists a dire need for a deliberate and extensive effort to mainstream gender issues into the countries' adaptation response mechanisms to climate variability. Driven by the theory of eco-Feminism, women and nature rely on each other "mother earth"; therefore they tend to have more to lose and more vulnerable in comparison to their male counterparts simply because they have special connection to the environment through their daily interactions with it. It is therefore imperative for the government of Zimbabwe and its implementing partners to undertake gender analysis initiatives when undertaking mechanisms that reduce the risks of smallholder farmers to climate variability. Chagutah (2010) in a country report concurred with the eco-feminist that, the vulnerability of women to climate variability should be acknowledged, researched and integrated into planning and strategy building. Henceforth, the government and its complementary partners should empower smallholder women on the technical knowhow to adapt to the threats posed by climate variability simply because they undertake the essential work such as planting, hoeing, weeding, harvesting and storage. Thus empowerment may increase their capacity to withstand the pressures posed by climate variability on their livelihoods and enhance food security in the long run.

3.3 CONCLUSION

In spite of the vulnerability of rain-fed agriculture to climate variability, smallholder farmers should not remain passive to its risks; they should rather adapt to climate variability through implementation of various mentioned strategies. This however requires a continuous transformation in processes and practises for effectiveness in the fight against climate variability related risks. However their capacity to combat weather related risks had been influenced by constraints such as poverty among other factors.

GENERAL CONCLUSION

The study explored that, climate variability has posed insurmountable constraints on the sustainability of agricultural productivity among the smallholder farmers and proved it unequivocal that, climate variability is indeed one of the greatest global challenge faced by mankind. In the first chapter, the study highlighted variability in weather trends, as indicated by erratic rainfall patterns, increases in temperatures and increases in the frequency of droughts. The followed chapter indicated that, smallholder farmers are aware of climate variability and acknowledged the dramatic weather variations that are occurring since the turn of the new millennium. They perceived variability in rainfall patterns, general increases in seasonal temperatures, successive hot and dry spells during the summer season and recurrence of extreme weather conditions mainly droughts. The study showed that, climatic related variations has inevitably threatened the sustainability of agriculture and livestock production thereby eroding livelihood capabilities of smallholder farmers and increased their vulnerability to risk factors. In as much as climate variability has caused extensive crop and livestock failures in Ward 9 and the district at large, it should be underscored that the smallholder farmers have not remained as passive victims. The final chapter indicated that, the threats posed by climate variability can be reduced in the future if there is proper commitment by all stakeholders that is, if the government institutions like AGRITEX shows commitment, the implementing partners (NGOs) and also the affected communities as well adopts the mentioned mechanisms within their capacity. The adaptation mechanisms that are imperative to cushion the impacts of climate variability on smallholder farmers includes diversification of livelihoods, diversification of crops as well livestock small grains and adoption of conservative farming methods.

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APPENDIX A

QUESTIONNAIRE: Smallholder Farmers.

My name is Trace Mudondo, a student at Midlands State University and kindly asking for your assistance in my academic research. I am undertaking an academic research entitled, **"The impact of climate variability on small holder farmers in Zimbabwe: A case of Makoni District, Ward 9 (2000-2012)".** May you kindly respond to this questionnaire by ticking to the answer and providing information in detail where necessary. The information you give will be solely for this research and strict confidentiality will be maintained. Do not write your name.

Section A: Demographic Information

1. Age

a) 18-38 ☐

b) 39-59 ☐

c) 60 and above ☐

2. Sex

Male ☐ Female ☐

SECTION B: FARMERS PERCEPTIONS ON CLIMATE VARIABILITY.

1. How do you rate your knowledge and understanding about climate variability?

Poor ☐ Fair ☐ Good ☐ Excellent ☐

2a) Have you noticed any variations in Climatic Conditions? Indicate with a tick and if Yes move on to question 2b.

Yes ☐ No ☐

2b) If yes, what are your own experiences in rainfall amounts and patterns

Rainfall amounts	…….....
Onset of summer session	…….....
Cessation of summer	…….....
Distribution within seasons	……
Spatial distribution	……...

3) From your own experience are there any deviations in temperatures patterns? Y ☐ N ☐

b) If yes, explain the seasonal temperatures variations

Summer temperatures……

Winter temperatures……..

4a) Apart from the above mentioned observations, is the frequency of droughts increasing or decreasing?

4b) If increasing, explain the trend …….

5a) Have you ever experienced flooding? Yes ☐ No ☐

5b) If your answer is yes, comment on the trend…….

SECTION C: IMPACTS OF CLIMATE VARIABILITY ON CROP AND LIVESTOCK PRODUCTION.

6) How has the above perceived climatic variations affected your crop production?

……..

7) May you give a comparison of the yields before 2000 and after the new millennium?

a. Before 2000…….....

b. After 2000 to present……...

8) How has the experienced weather vagaries impacted on your livestock production?

……..

SECTION D: ADAPTATION MECHANISMS

9) Do you have any measures that you have implemented to combat the above mentioned impacts?

Yes ☐ No ☐

10) If yes, what strategies have you put in place to protect both your livestock and crops?

……

……..

11) Of the above mentioned adaptation strategies, which ones were the most effective?

…….

ANY FURTHER COMMENTS

APPENDIX B

Semi-Structured Interview guide for the Key Informants

My name is Trace Mudondo, a student at Midlands State University and kindly asking for your assistance in carrying my academic research. I am undertaking an academic research entitled, **"The impact of climate variability on small holder farmers in Zimbabwe: A case of Makoni District, Chinyika Resettlement area (2000-2012)".** The information you give will be solely for this research and strict confidentiality will be maintained.

NB: In answering, give statistics where possible.

1. May you briefly outline the climatic conditions of Makoni District?

2. What climatic variations have been occurring in the area since 2000?

3. Are there any variations in the trend and occurrence of extreme weather conditions during the past decade?

4. How have the above mentioned climate variations in weather conditions affected:

   a) Crop production

   b) Livestock production

5. What mechanisms have you encouraged on the smallholder farmers in order to reduce the impact of climate variability on their crop and livestock production?